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mercruiser

SERVICE MANUAL

Number 15

MARINE ENGINES

GM V-8 Cylinder

©1992, Brunswick Corporation

Printed in U.S.A.

90-816463 392

V8 Models Covered In This Manual

Alpha Engines

Models	Serial Numbers	Years
MCM 5.0L	0C408718-0D832471	1989-1992
MCM 5.0LX	0C407922-0D831002	
MCM 5.7L	0C408286-0D830699	
MCM 350 Magnum	0C407752-0D830981	

Bravo Engines

Models	Serial Numbers	Years
MCM 5.0L	0D713710-0D833076	1992
MCM 5.7L	0C407810-0D831825	1989-1992
MCM 7.4L	0C407647-0D830778	
MCM 454 Magnum	0C407647-0D837586	
MCM 502 Magnum	0C878221-0D840099	1990-1992

Ski Engines

Models	Serial Numbers	Years
MIE 5.7L Competition Ski	0C410403-0D840219	1989-1992
MIE 350 Magnum Competition Ski	0D505374-0D840099	1991-1992

Inboard Engines

Models	Serial Numbers	Years
MIE 5.7L	0C396695-0D839999	1989-1992
MIE 7.4L	0C396833-0D840299	
MIE 8.2L	0C878221-0D857199	1990-1992

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- F - MIE Models - Hurth Transmission

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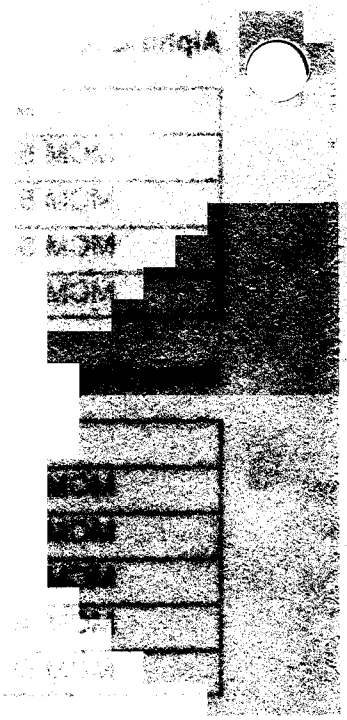


Notice

Throughout this publication, "Dangers", "Warnings" and "Cautions" are used to alert the mechanic to special instructions concerning a particular service or operation that may be hazardous if performed incorrectly or carelessly. —— Observe them carefully!

These "Safety Alerts" alone cannot eliminate the hazards that they signal. Strict compliance to these special instructions when performing the service, plus "common sense" operation, are major accident prevention measures.

⚠DANGER

DANGER — Immediate hazards which WILL result in severe personal injury or death.

⚠WARNING

WARNING — Hazards or unsafe practices which COULD result in severe personal injury or death.

⚠CAUTION

CAUTION — Hazards or unsafe practices which could result in minor personal injury or product or property damage.

Notice to Users of This Manual

This service manual has been written and published by the service department of Mercury Marine to aid our dealers, mechanics and company service personnel when servicing the products described herein.

It is assumed that these personnel are familiar with the servicing procedures of these products, of like or similar products manufactured and marketed by Mercury Marine. That they have been trained in the recommended servicing procedures of these products which includes the use of mechanic's common hand tools and the special Mercury Marine or recommended tools from other suppliers.

We could not possibly know of and advise the service trade of all conceivable procedures by which a service might be performed and of the possible hazards and/or results of each method. We have not undertaken any such wide evaluation. Therefore, anyone who uses a service procedure and/or tool, which is not recommended by the manufacturer, first must completely satisfy himself that neither his nor the product's safety will be endangered by the service procedure selected.

All information, illustrations and specifications contained in this manual are based on the latest product information available at time of publications.

It should be kept in mind, while working on the product, that the electrical system and ignition system is capable of violent and damaging short circuits or severe electrical shocks. When performing any work where electrical terminals could possibly be grounded or touched by the mechanic, the battery cables should be disconnected at the battery.

Any time the intake or exhaust openings are exposed during service they should be covered to protect against accidental entrance of foreign material which could enter the cylinders and cause extensive internal damage when the engine is started.

It is important to note that, during any maintenance procedure, replacement fasteners must have the same measurements and strength as those removed, whether metric or customary. Numbers on the heads of the metric bolts and on surfaces of metric nuts indicate their strength. Customary bolts use radial lines for this purpose, while most customary nuts do not have strength markings. Mismatched or incorrect fasteners can result in damage or malfunction, or possible personal injury. Therefore, fasteners removed should be saved for re-use in the same locations whenever possible. Where the fasteners are not satisfactory for re-use, care should be taken to select a replacement that matches the original.

Replacement Parts

⚠WARNING

Electrical, ignition and fuel system componets on MerCruiser Engines and Stern Drives are designed and manufactured to comply with U.S. Coast Guard Rules and Regulations to minimize risks of fire or explosion.

Use of replacement electrical, ignition or fuel system components, which do not comply to these rules and regulations, could result in a fire or explosion hazard and should be avoided.

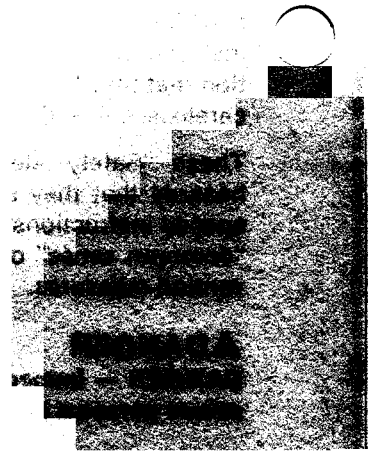
When servicing the electrical, ignition and fuel systems, it is extremely important that all components are properly installed and tightened. If not, any electrical or ignition component opening would permit sparks to ignite fuel vapors from fuel system leaks, if they existed.

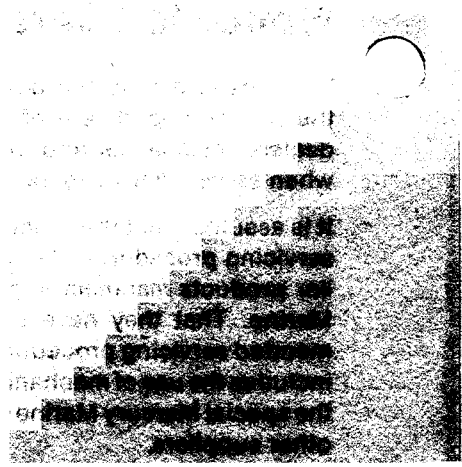
Engine Mechanical Components

Many of the engine mechanical components are designed for marine applications. Unlike automotive engines, marine engines are subjected to extended periods of heavy load and wide-open-throttle operation, therefore, require heavy-duty components. Special marine engine parts have design and manufacturing specifications which are required to provide long life and dependable performance. Marine engine parts also must be able to resist the corrosive action of salt or brackish water that will rust or corrode standard automotive parts within a short period of time.

Failure to use recommended Quicksilver service replacement parts can result in poor engine performance and/or durability, rapid corrosion of parts subjected to salt water and possibly complete failure of the engine.

Use of parts other than recommended service replacement will void the warranty on those parts which are damaged as a result of the use of other than recommended parts.

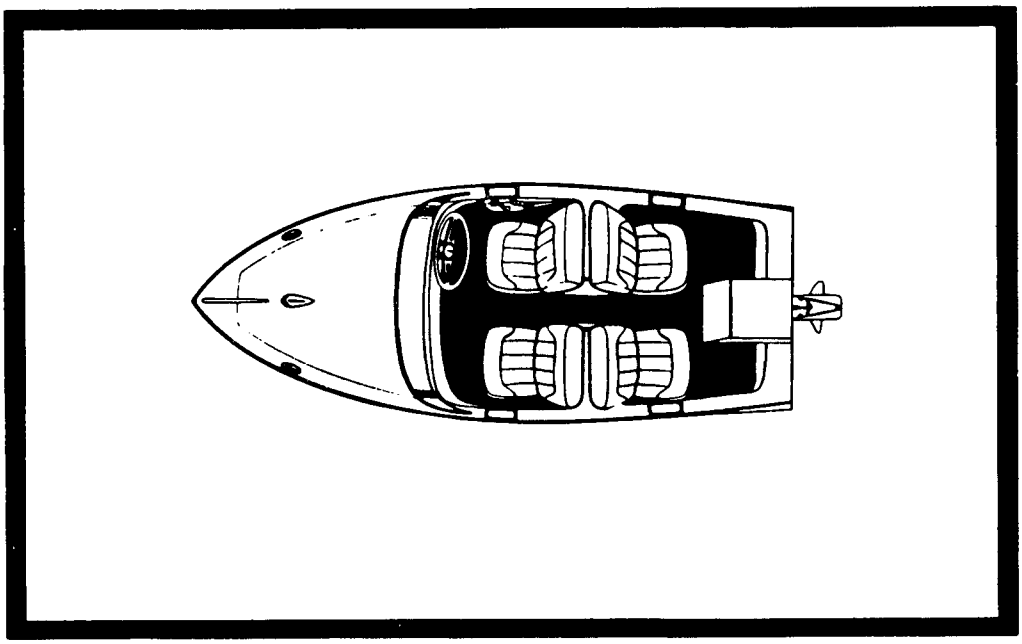




IMPORTANT INFORMATION

1

A



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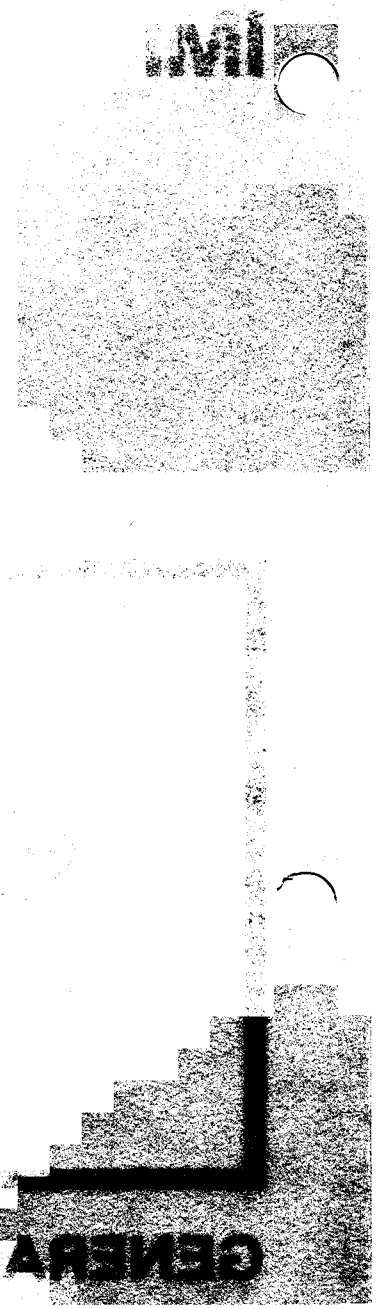


NOTICE

Refer to Appropriate Stern Drive service manual for transom assembly and Stern Drive unit repair.

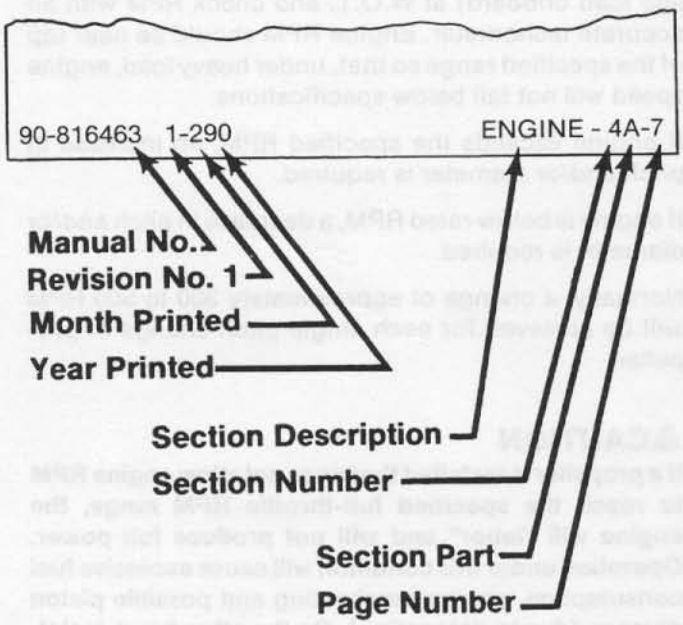
How to Use This Manual

This manual is divided into sections which represent major components and systems.

Some sections are further divided into parts which more fully describe the component.

Page Numbering

Two number groups appear at the bottom of each page. Following is an example and description.



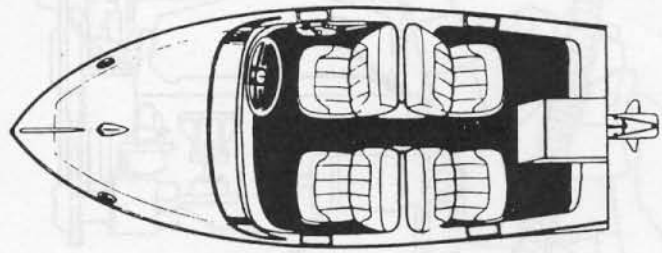
Introduction

This comprehensive overhaul and repair manual is designed as a service guide for the models previously listed. It provides specific information, including procedures for disassembly, inspection, assembly and adjustment. To enable dealers and service mechanics to repair and tune these engines.

Before attempting repairs or tune up, it is suggested that the procedure first be read through to gain knowledge of the methods and tools used and the cautions and warnings required for safety.

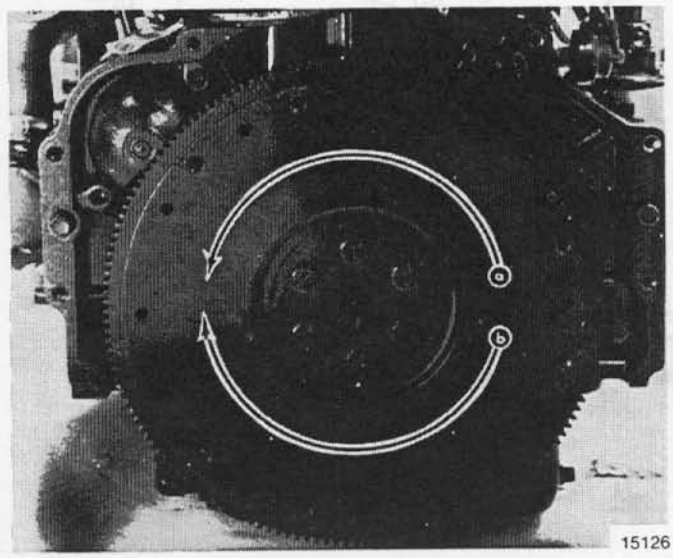
Directional References

Front of boat is bow; rear is stern. Starboard side is right side; port side is left side. In this maintenance manual, all directional references are given as they appear when viewing boat from stern, looking toward bow.



Engine Rotation

Engine rotation is determined by observing flywheel rotation from the rear (stern end) of the engine looking forward (water pump end). Propeller rotation is not necessarily the same as engine rotation. When ordering replacement engine, short blocks or parts for engine, be certain to check engine rotation. Do not rely on propeller rotation in determining engine rotation.

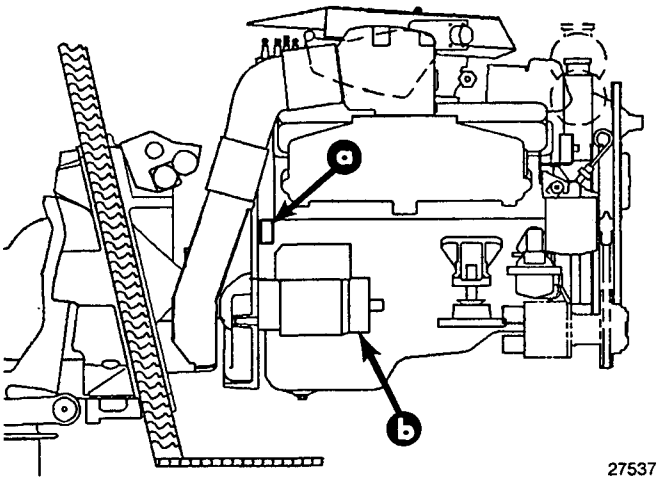


15126

a - Standard Left Hand Rotation - All MCM Stern Drive Engines; MIE Inboard L.H. Rotation Engines

b - Opposite Right Hand Rotation - MIE Inboard R.H. Rotation Engines

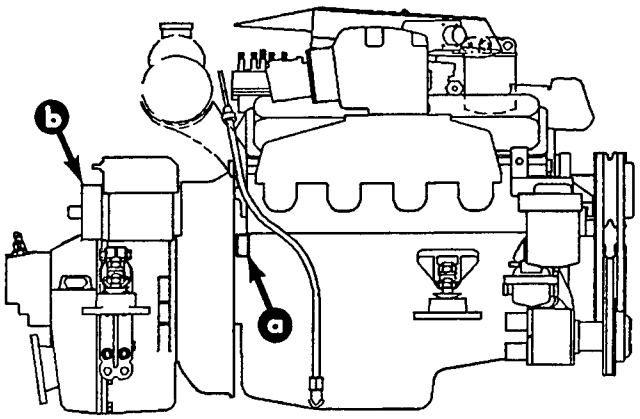
Engine Serial Number Locations



27537

a - Serial Number Plate
b - Starter Motor

MCM - All Engines



27576

a - Serial Number Plate
b - Starter Motor

MIE - All Engines

Propeller Information

Refer to the "Propeller" Section in appropriate MerCruiser Stern Drive Service Manual, or order publication P/N 90-86144 "What You Should Know About Quicksilver Propellers."

Changing diameter, pitch or coupling of a propeller will affect engine RPM and boat performance. The blade configuration also will affect performance. Two like propellers, same pitch and diameter, from two different manufacturers also will perform differently.

It is the responsibility of the boat manufacturer and/or selling dealer to equip the boat with the correct propeller to allow the engine to operate within its specified RPM range at wide open throttle (W.O.T).

Because of the many variables of boat design and operation, only testing will determine the best propeller for the particular application.

To test for correct propeller, operate boat (with an average load onboard) at W.O.T. and check RPM with an accurate tachometer. Engine RPM should be near top of the specified range so that, under heavy load, engine speed will not fall below specifications.

If engine exceeds the specified RPM, an increase in pitch and/or diameter is required.

If engine is below rated RPM, a decrease in pitch and/or diameter is required.

Normally, a change of approximately 300 to 500 RPM will be achieved for each single pitch change of propeller.

⚠CAUTION

If a propeller is installed that does not allow engine RPM to reach the specified full-throttle RPM range, the engine will "labor" and will not produce full power. Operation under this condition will cause excessive fuel consumption, engine overheating and possible piston damage (due to detonation). On the other hand, installation of a propeller, that allows engine to run above the specified RPM limit, will cause excessive wear on internal engine parts which will lead to premature engine failure.

Hi-Performance Boating

Written by Marine Engineers, order publication P/N 90-86168, entitled "Hi-Performance Boat Operation."

Engine 20-Hour Break-In Period

IMPORTANT: Proper break-in is essential to obtaining minimum oil consumption, maximum engine performance and service.

The first 20 hours of operation is the engine (new or rebuilt) break-in period. During this period, it is extremely important that the engine is operated, as outlined following.

1. Do not operate engine below 1500 RPM for extended periods of time during the first 10 hours. During this period, shift into gear as soon as possible after starting engine and advance throttle so that RPM is above 1500 (provided that conditions permit safe operation at this speed).
2. Do not operate at any one constant speed for extended periods of time.
3. Do not exceed 3/4 of full throttle during the first 10 hours of operation. During the next 10 hours, occasional operation at full throttle (5 minutes at-a-time maximum) is permissible.
4. Avoid full throttle acceleration from stopped position.
5. Do not operate at full throttle until engine reaches normal operating temperature.
6. Observe instrumentation carefully. If an abnormal reading occurs, stop engine immediately and determine cause.
7. Frequently check crankcase oil level and add oil if necessary. It is normal for oil consumption to be somewhat high during the break-in period.
8. At end of 20-hour break-in period, drain break-in oil from crankcase and replace oil filter. Fill crankcase with correct grade and viscosity oil.

20-Hour Checkup

After first 20 hours of operation, an Authorized MerCruiser Dealer should be contacted for the following maintenance. The boat owner is responsible for any charges.

- Change crankcase oil and filter.
- Hurth Transmissions, only - change transmission filter.
- Magnum Models Only - retorque intake manifold to 35 lb. ft. (48 N·m).
- Check all fluid levels.
- Cooling System - Inspect all hoses for damage and deterioration; check all hose clamps for adequate tightness.
- Check carburetor adjustment.
- Inspect ignition system and timing.
- Check for loose, missing or damaged parts.
- Check shift and throttle cable adjustments - lubricate and inspect for loose, damaged or missing parts.
- Steering System - Lubricate and inspect for loose, damaged or missing parts.
- Inspect all drive belts.
- Check engine alignment.
- Complete Engine Exhaust System Inspection - Inspect for damaged and deterioration; check all hose clamps for adequate tightness.
- Retorque gimbal ring clamping U-bolt to 40 lb. ft. (54 N·m).
- Change oil in Seawater/Fuel Pump (if so equipped). Use only Quicksilver High Performance Gear Lube to refill pump.

Water Testing New Engines

Use care during the first 20 hours of operation on new MerCruiser engines or possible engine failure may occur. If a new engine has to be water-tested at full throttle before the break-in period is complete, follow this procedure.

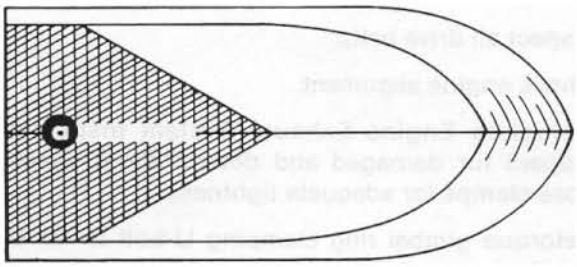
1. Start engine and run at idle RPM until normal operating temperature is reached.
2. Run boat up on plane.
3. Advance engine RPM (in 200 RPM increments) until engine reaches its maximum rated RPM.

IMPORTANT: Do not run at maximum RPM for more than 2 minutes.

Boat and Engine Performance

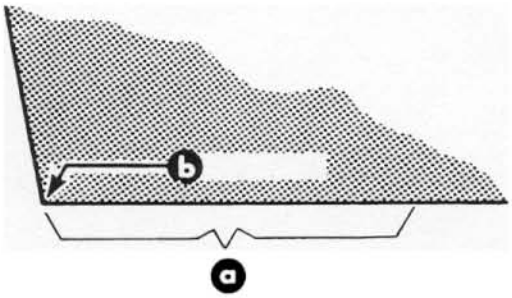
Boat Bottom

For maximum speed, a boat bottom should be as flat as possible in a fore-aft direction (longitudinally) for approximately the last 5 ft. (1.5m).



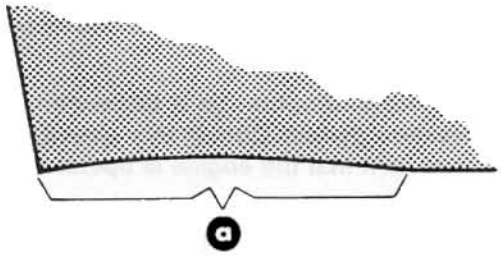
a - Critical Bottom Area

For best speed and minimum spray, the corner between the bottom and the transom should be sharp.



a - Flat
b - Sharp Corner

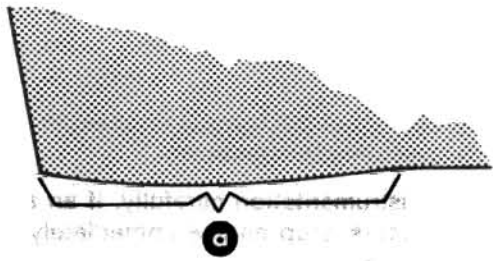
The bottom is referred to as having a "hook" if it is concave in the fore-and-aft direction. A hook causes more lift on the bottom near the transom and forces the bow to drop. This increases wetted surface and reduces boat speed. A hook, however, aids in planing and reduces any porpoising (rhythmical bouncing) tendency. A slight hook is often built in by the manufacturer. A hook also can be caused by incorrect trailering or storing the boat with support directly under the transom.



a - Hook

A "rocker" is the reverse of a hook. The bottom is convex or bulged in the fore-and-aft direction. It can cause the boat to porpoise.

Any hook, rocker or surface roughness on the bottom, particularly in the all-important center-aft portion will have a negative effect on speed, often several miles-per-hour on a fast boat.



a - Rocker

Marine Fouling

Fouling is an unwanted build-up (usually animal-vegetable-derived) occurring on the boat's bottom and drive unit. Fouling adds up to drag, which reduces boat performance. In fresh water, fouling results from dirt, vegetable matter, algae or slime, chemicals, minerals and other pollutants. In salt water, barnacles, moss and other marine growth often produce dramatic build-up of material quickly. So it is important to keep the hull as clean as possible in all water conditions to maximize boat performance.

Special hull treatments, such as anti-fouling paint, will reduce the rate of bottom fouling. However, due to the fact that drive units (outboard or stern drive) are made primarily of aluminum, be sure to select an anti-fouling paint having a copper-free, organo-tin base. The BIS (Tri Butyl Tin) Adipate (TBTA) base paint will not set up a galvanic corrosion "cell" as it is completely compatible with aluminum and avoids any electrolysis problems connected with many other paints. Applied according to instructions, it also is very effective.

Weight Distribution

Weight distribution is extremely important; it affects a boat's running angle or attitude. For best top speed, all movable weight — cargo and passengers — should be as far aft as possible to allow the bow to come up to a more efficient angle (3° to 5°). On the negative side of this approach is the problem that, as weight is moved aft, some boats will begin an unacceptable porpoise.

Secondly, as weight is moved aft, getting on plane becomes more difficult.

Finally, the ride in choppy water becomes more uncomfortable as the weight goes aft. With these factors in mind, each boater should seek out what weight locations best suits his/her needs.

Weight and passenger loading placed well forward increases the "wetted area" of the boat bottom and, in some cases, virtually destroys the good performance and handling characteristics of the boat. Operation in this configuration can produce an extremely wet ride, from wind-blown spray, and could even be unsafe in certain weather conditions or where bow steering may occur.

Weight distribution is not confined strictly to fore and aft locations, but also applies to lateral weight distribution. Uneven weight concentration to port or starboard of the longitudinal centerline can produce a severe listing attitude that can adversely affect the boat's performance, handling ability and riding comfort. In extreme rough water conditions, the safety of the boat and passengers may be in jeopardy.

Water in Boat

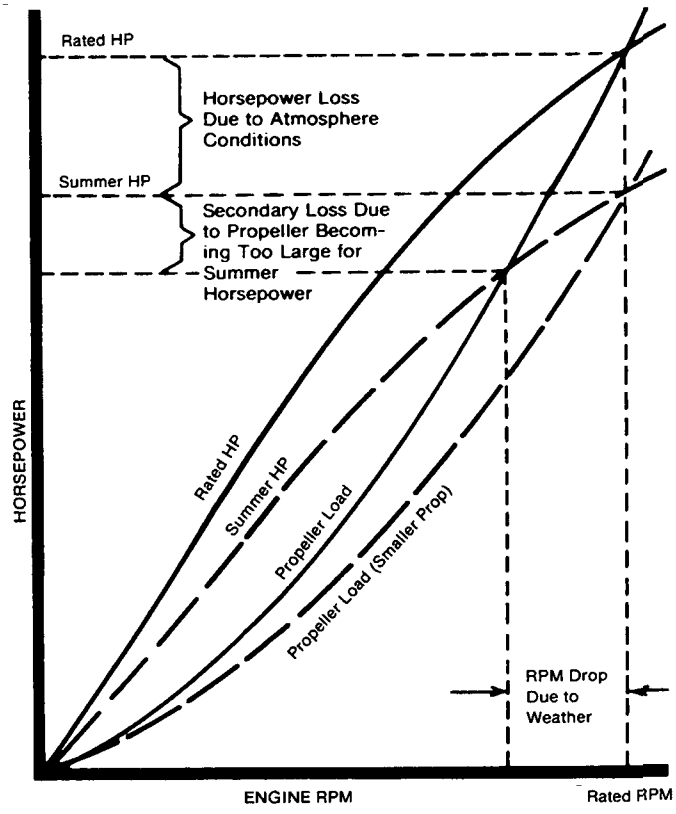
When a boat loses performance, check bilge for water. Water can add considerable weight to the boat, thereby decreasing the performance and handling.

Make certain that all drain passages are open for complete draining.

Elevation and Climate

Elevation has a very noticeable effect on the wide-open-throttle power of an engine. Since air (containing oxygen) gets thinner as elevation increases, the engine begins to starve for air. Humidity, barometric pressure and temperature do have a noticeable effect on the density of air. Heat and humidity thin the air. This phenomenon can become particularly annoying when an engine is propped out on a cool, dry day in spring and later, on a hot, sultry day in August, doesn't have its old zip. (See chart)

Although some performance can be regained by dropping to a lower-pitch propeller, the basic problem still exists. The propeller is too large in diameter for the reduced power output. The experienced marine dealer or a Quicksilver Propeller Repair Station can determine how much diameter to remove from a lower-pitch propeller for specific high-elevation locations. In some cases, a gear-ratio change to the drive unit to more reduction is possible and very beneficial. It is a known fact that weather conditions exert a profound effect on power output of internal combustion engines. Therefore, established horsepower ratings refer to the power that the engine will produce at its rated RPM under a specific combination of weather conditions.



IMPORTANT INFORMATION

1

B

Scheduled Maintenance to be Performed by Dealer

TASK	INTERVAL
20-Hour Checkup (See NOTE 1)	At First 20 Hours of Operation.
Seawater Pickup Pump - Disassemble and Inspect	Whenever Insufficient Seawater Flow is Suspected. (If Operating Temperature Exceeds Normal Range.)
Transmission Fluid - Change	After first 20 hours of operation, then every 100 hours of operation thereafter.
Transmission Filter (Hurth Transmissions) - Change	
Flame Arrestor and Crankcase Ventilation Hose - Clean and inspect	Every 100 Hours of Operation or Once Yearly, Whichever Occurs First.
Stern Drive Unit Oil - Change	
Gimbal Ring Clamping Screws - Retorque to 40 lb. ft. (54 N·m)	
Intake Manifold (Magnum and 8.2L Models Only) - Retorque to 35 lb. ft. (48 N·m)	
Seawater/Fuel Pump (If So Equipped) - Check Oil	
Engine Alignment - Check	
Transom Gimbal Housing Assembly Swivel Shaft and Gimbal Bearing - Lubricate	
Engine Coupling, Universal Joint Shaft Splines - Lubricate*	

MAINTENANCE

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Maintenance Schedule

⚠CAUTION
Always disconnect battery cables from battery BEFORE working around electrical system components to prevent injury to yourself or damage to electrical system should a wire be accidentally shorted.

Only perform maintenance which applies to your particular power package.

Scheduled Maintenance to be Performed by Owner/Operator

TASK	INTERVAL
Seawater Strainer - Check and Clean	Before Use
Water Pickups - Check for marine growth or debris	Whenever Insufficient Seawater Flow is Suspected. (If Operating Temperature Exceeds Normal Range).
Engine Crankcase Oil - Check level (See NOTE 1)	Weekly
Transmission Fluid - Level Check	
Closed Cooling Coolant - Check level	
Power Steering Fluid - Check level	
Stern Drive Unit Oil - Check level	
Battery - Check level and inspect for damage	
Fuel Pump Sight Tube - Check that no fuel is present	
Power Trim Pump Oil - Check level	
Anodes - Inspect for erosion	
Drive Belts (All) - Inspect condition and check tension	Every 100 Hours of Operation or 120 Days, Whichever Occurs First.
Propeller Shaft - Lubricate	**Saltwater use:** Every 50 Hours of Operation or 60 Days, Whichever Occurs First. **Freshwater use:** Every 100 Hours of Operation or 120 Days, Whichever Occurs First.
Power Package Exterior Surfaces - Spray with rust preventative	
Power Package Exterior Surfaces - Clean and paint	Once a Year.
Cooling System - Flush seawater section	**Saltwater use:** After Each Use.

NOTE 1: 454 Magnum, 502 Magnum and 8.2L Models - Check every 3 hours of operation.

Maintenance (Continued)

Only perform maintenance which applies to your particular power package.

Scheduled Maintenance to be Performed by Dealer

TASK	INTERVAL
20-Hour Checkup (See NOTE 1)	At First 20 Hours of Operation.
Seawater Pickup Pump - Disassemble and Inspect	Whenever Insufficient Seawater Flow is Suspected. (If Operating Temperature Exceeds Normal Range.)
Transmission Fluid - Change	After first 20 hours of operation, then every 100 hours of operation thereafter.
Transmission Filter (Hurth Transmissions) - Change	
Flame Arrestor and Crankcase Ventilation Hose - Clean and inspect	Every 100 Hours of Operation or Once Yearly, Whichever Occurs First.
Stern Drive Unit Oil - Change	
Gimbal Ring Clamping Screws - Retorque to 40 lb. ft. (54 N·m)	
Intake Manifold (Magnum and 8.2L Models Only) - Retorque to 35 lb. ft. (48 N·m)	
Seawater/Fuel Pump (If So Equipped) - Check Oil	
Engine Alignment - Check	
Transom Gimbal Housing Assembly Swivel Shaft and Gimbal Bearing - Lubricate	
Engine Coupling, Universal Joint Shaft Splines - Lubricate*	
Crankcase Oil and Filter - Change	
Ignition System - Clean and inspect condition	
Universal Joint Cross Bearings - Lubricate	Every 200 Hours of Operation or Once Yearly, Whichever Occurs First.
Steering System - Lubricate and inspect for loose, damaged or missing parts	**Saltwater use:** Every 50 Hours of Operation or 60 Days, Whichever Occurs First. **Freshwater use:** Every 100 Hours of Operation or 120 Days, Whichever Occurs First.
Electrical System - Check for loose or damaged wiring	

NOTE 1: For a list of 20-Hour Checkup maintenance items to be performed, see SECTION 1A - "IMPORTANT INFORMATION," of this manual.

*Use Quicksilver Engine Coupler Spline Grease (Part Number 92-816391A4).

Maintenance (Continued)

Only perform maintenance which applies to your particular power package.

Scheduled Maintenance to be Performed by Dealer

TASK	INTERVAL
Continuity Circuit - Check components for loose connections, broken or frayed wires.	**Saltwater use:** Every 50 Hours of Operation or 60 Days, Whichever Occurs First. **Freshwater use:** Every 100 Hours of Operation or 120 Days, Whichever Occurs First.
Shift and Throttle Cable and Linkage - Lubricate and inspect for loose, damaged or missing parts	
Cooling System Hoses and Clamps - Inspect for damage and deterioration. Check clamps for tightness.	
Engine Exhaust System - Inspect for damage, deterioration and restrictions. Check clamps for tightness.	
Ignition System - Check timing and adjust if needed	Once a Year
Fuel filters - Replace	
Steering Head and Remote Control - Inspect and lubricate	
Quicksilver MerCathode System - Test output	
Closed Cooling Coolant - Test for alkalinity	
Heat Exchanger - Clean seawater section	
Carburetor - Inspect and adjust	
Drive Unit Bellows and Clamps - Inspect	
Closed Cooling Coolant - Replace	Every Two Years

Tune-Up Specifications

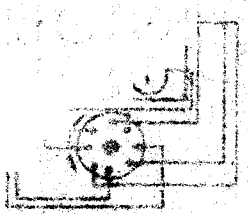
MODEL	MCM 5.0L	MCM 5.0LX	MCM 5.7L	MCM 350 MAGNUM
Number of Cylinders	V8			
Displacement	305 CID (5.0 Litre)		350 CID (5.7 Litre)	
Bore/Stroke	3.74/3.48 In. (95/88.4mm)		4.00/3.48 In. (101.6/88.4mm)	
Compression Ratio	9.3:1			
Compression Pressure	150 - 160 PSI (1034 - 1103 kPa)			
Idle RPM (In Forward Gear)	650 - 700			
Max. RPM (at W.O.T.)	4200 - 4600		4200 - 4600 4400 - 4800 (NOTE)	
Oil PSI (At 2000 RPM)	30 - 60 PSI (207 - 414 kPa)			
Min. Oil PSI (At Idle)	4 PSI (28 kPa)			
Fuel Pump PSI (At 1800 RPM)	4-1/2 - 5 PSI (31 - 34.5 kPa)			
Electrical System	12 Volt Negative (-) Ground			
Min. Battery Cold Cranking Amps	305		350 375 (NOTE)	
Firing Order	1-8-4-3-6-5-7-2			
Spark Plug Type	AC-MR43T/Champion RV8C			
Spark Plug Gap	.035 In. (0.9mm)			
Timing (At Idle RPM)	8° BTDC			
Preliminary Idle Mixture	1-1/4 Turns	2 - 3 Turns		
Thermostat	143° F (62° C)			

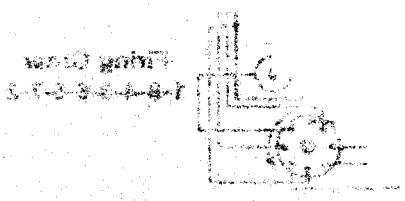
NOTE: Engines with roller lifters and matching camshaft; Engine Block Code "CD." See Engine Block Code Information, SECTION 3A.

Tune-Up Specifications
(Continued)

MODEL	MCM 7.4L	MCM 454 MAGNUM	MCM 502 MAGNUM
Number of Cylinders	V8		
Displacement	454 CID (7.4 Litre)		502 CID (8.2 Litre)
Bore/Stroke	4.25/4.00 In. (108/101.6mm)		4.47/4.00 In. (113.5/101.6mm)
Compression Ratio	8.5:1 8.6:1 (NOTE)	8.8:1 8.6:1 (NOTE)	8.75:1
Compression Pressure	150 - 160 PSI (1034 - 1103 kPa)		
Idle RPM (In Forward Gear)	650 - 700		
Max. RPM (at W.O.T.)	4200 - 4600	4600 - 5000	4600 - 5000
Oil PSI (At 2000 RPM)	30 - 70 PSI (207 - 483 kPa)		
Min. Oil PSI (At Idle)	4 PSI (28 kPa)		
Fuel Pump PSI (At 1800 RPM)	4-1/2 - 5 PSI (31 - 34.5 kPa) 3 - 7 PSI (21 - 48 kPa) (NOTE)		3 - 7 PSI (21 - 48 kPa)
Electrical System	12 Volt Negative (-) Ground		
Min. Battery Cold Cranking Amps	450		550
Firing Order	1-8-4-3-6-5-7-2		
Spark Plug Type	AC-MR43T/Champion RV8C		
Spark Plug Gap	.035 In. (0.9mm)		
Timing (At Idle RPM)	8° BTDC		
Preliminary Idle Mixture	2 - 3 Turns		
Thermostat	143° F (62° C)		

NOTE: Generation V Engines (engines with Cast Aluminum Rocker Arm Covers and lack of engine block fuel pump mounting pad).



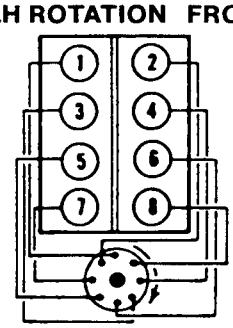


Tune-Up Specifications
(Continued)

MODEL	MIE 5.0 Litre	MIE 5.7 Litre	MIE 7.4 Litre	MIE 8.2 Litre
Number of Cylinders	V8			
Displacement	305 CID (5.0 L)	350 CID (5.7 L)	454 CID (7.4 L)	502 CID (8.2 L)
Bore/Stroke	3.74/3.48 In. (95/88.39mm)	4.00/3.48 In. (101.6/88.39mm)	4.25/4.00 In. (108/101.6mm)	4.47/4.00 In. (113.5/101.6mm)
Compression Ratio	9.3:1		8.5:1 8.6:1 (NOTE)	8.75:1
Compression Pressure	180 PSI (1241 kPa)		180 PSI (1241 kPa) 150 PSI (1035 kPa) (NOTE)	150 PSI (1035 kPa)
Idle RPM (In Forward Gear)	650 - 700 RPM			
Max. RPM (at W.O.T.)	4000 - 4400 RPM			4400 - 4800 RPM
Oil PSI (At 2000 RPM)	30 - 60 PSI (207 - 414 kPa)		30 - 70 PSI (207 - 483 kPa)	
Min. Oil PSI (At Idle)	4 PSI (28 kPa)			
Fuel Pump PSI (At 1800 RPM)	4-1/2 - 5 PSI (31 - 34.5 kPa)		4-1/2 - 5 PSI (31 - 34.5 kPa) 3 - 7 PSI (21 - 48 kPa) (NOTE)	3 - 7 PSI (21 - 48 kPa)
Electrical System	12 Volt Negative (-) Ground			
Min. Battery Cold Cranking Amps	305	350	450	550
Firing Order	A or B			A only
Spark Plug Type	AC-MR43T/Champion RV8C			
Spark Plug Gap	.035 In. (0.9mm)			
Timing (At Idle RPM)	8° BTDC			12° BTDC
Preliminary Idle Mixture	2 - 3 Turns			
Thermostat	143° F (62° C)			

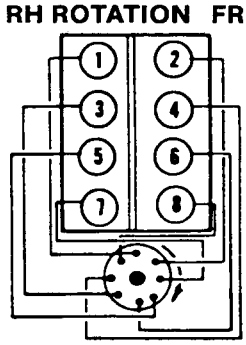
NOTE: Generation V Engines (engines with Cast Aluminum Rocker Arm Covers and lack of engine block fuel pump mounting pad).

A LH ROTATION FRONT



Firing Order
1-8-4-3-6-5-7-2

B RH ROTATION FRONT



Firing Order
1-2-7-5-6-3-4-8

Tune-Up Specifications
(Continued)

MODEL	MIE 5.7 Litre Comp. Ski	MIE 350 Magnum Tournament Ski
Number of Cylinders	V8	
Displacement	350 CID (5.7 L)	
Bore/Stroke	4.00/3.48 In. (102/88mm)	
Compression Ratio	9.3:1	
Compression Pressure	180 PSI (1241 kPa)	150 PSI (1035 kPa)
Idle RPM (In Forward Gear)	650 - 700	
Max. RPM (at W.O.T.)	4000 - 4400	4400 - 4800
Oil Pressure (At 2000 RPM)	30 - 60 PSI (207 - 414 kPa)	
Min. Oil Pressure (At Idle)	4 PSI (28 kPa)	
Fuel Pump Pressure	4-1/2 - 5 PSI (31 - 34.5 kPa)	3 - 7 PSI (21 - 48 kPa)
Electrical System	12 Volt Negative (-) Ground	
Min. Battery Cold Cranking Amps	350	375
Firing Order	L.H. Rot. 1-8-4-3-6-5-7-2 R.H. Rot. 1-2-7-5-6-3-4-8	L.H. Rot. 1-8-4-3-6-5-7-2
Spark Plug Type	AC-MR43T/Champion RV8C	
Spark Plug Gap	.035 In. (0.9mm)	
Breaker Point Gap	.016 - .019 In. (0.40 - 0.48mm)	Not Applicable (Thunderbolt IV HEI)
Dwell	28° - 31°	
Breaker Point Spring Tension	25 - 30 Oz. (709 - 850g)	
Timing (At Idle RPM)	10° BTDC	8° BTDC
Preliminary Idle Mixture	2 - 3 Turns	
Thermostat	143° F (62° C)	

Fluid Capacities

NOTICE
All capacities are approximate fluid measures.
Units: U.S. Qts. (L)

MIE MODEL	5.0L	5.7L	350 Magnum Tournament Ski/ 5.7 COMP. SKI	7.4L	8.2L
Crankcase Oil[1] Capacity w/New Filter	6 Qts. (5.7L)		4 Qts. (3.8L)[3] 5 Qts. (4.73L)[4]	8 Qts. (7.57L) 7 Qts. (6.6L)[5]	8 Qts. (7.57L)
Seawater Cooling System[2]	15 Qts. (14.1L)			20 Qts. (19.3L)	
Closed Cooling System[2]	20 Qts. (19L)			28 Qts. (26.5L)	
Transmission[1] (Borg-Warner) 1:1	2 Qts. (1.9L)				
Transmission[1] (Borg-Warner) 1.5:1 - 3.0:1	3 Qts. (2.9L)				
Transmission[1] (Borg-Warner) All V-Drives	4-1/2 Qts. (4.5L)			4-1/2 Qts. (4.5L)	
Transmission[1] (Hurth - 630A) - 8° Down Angle				4-1/4 Qts. (4.0L)	
Transmission[1] (Hurth) - V-Drive				5 Qts. (4.8L)	
Transmission[1] (Hurth - 800A) - Down Angle				4-1/2 Qts. (4.2L)	

[1]Always use dipstick to determine exact quantity of oil required

[2]Seawater Cooling System capacity information is for winterization use only

[3]1988-89 Engines

[4]1990 and Newer Engines

[5]Generation V Engines (engines with Cast Aluminum Rocker Arm Covers and lack of engine block fuel pump mounting pad)

MCM MODEL	5.0L	5.0LX 5.7L 350 MAGNUM	7.4L 454 MAGNUM 502 MAGNUM
Crankcase Oil[1] (with Filter)	5 Qts. (4.7L)	5-1/2 Qts. (5.2L) 5 Qts. (4.7L)[3]	8 Qts. (7.57L) 7 Qts. (6.6L)[4]
Seawater Cooling System[2]	15 Qts. (14.1L)		20 Qts. (19L)
Closed Cooling System	20 Qts. (19L)		28 Qts. (26.5L)

[1]Always use dipstick to determine exact quantity of oil required

[2]Seawater Cooling System capacity information is for winterization use only

[3]Engines with roller lifters and matching camshaft; Engine Code "CD." See Engine Block Code Information, SECTION 3A

[4]Generation V Engines (engines with Cast Aluminum Rocker Arm Covers and lack of engine block fuel pump mounting pad)

Fuel Specifications

Fuel

⚠CAUTION

Use of improper gasoline can damage the engine seriously. Engine damage, that results from use of improper gasoline, is considered misuse of the engine and is not covered under MerCruiser Warranty.

The use of any good grade unleaded regular or premium gasolines with a minimum posted octane rating [(A.K.I.) Anti-Knock Index] of 87, are satisfactory for use in your engine. In areas where unleaded regular or premium gasolines are not available, a good grade **leaded** regular with a minimum posted octane rating (A.K.I.) of 89 may be used. However, gasolines containing alcohol, either methyl alcohol (methanol) or ethyl alcohol (ethanol) may cause increased:

- Corrosion of metal parts.
- Deterioration of elastomer and plastic parts.
- Fuel permeation through flexible fuel lines.
- Wear and damage of internal engine parts.
- Starting and operating difficulties.

Some of these adverse effects are due to the tendency of gasolines containing alcohol to absorb moisture from the air, resulting in a phase of water and alcohol separating from the gasoline in the fuel tank.

The adverse effects of alcohol are more severe with methyl alcohol (methanol) and are worse with increasing alcohol content.

⚠WARNING

FIRE AND EXPLOSION HAZARD: Fuel leakage from any part of the fuel system can be a fire and explosion hazard which can cause serious bodily injury or death. Careful periodic inspection of the entire fuel system is mandatory, particularly after storage. All fuel components including fuel tanks, whether plastic, metal or fiberglass, fuel lines, primer bulbs, fittings, fuel filters and carburetors should be inspected for leakage, softening, hardening, swelling or corrosion. Any sign of leakage or deterioration requires replacement before further engine operation.

Because of possible adverse effects of alcohol in gasoline, it is recommended that only alcohol-free gasoline be used where possible. If only fuel containing alcohol is available, or if the presence of alcohol is unknown, increased inspection frequency for leaks and abnormalities is required.

IMPORTANT: When operating a MerCruiser engine on gasoline containing alcohol, storage of gasoline in the fuel tank for long periods should be avoided. Long periods of storage, common to boats, create unique problems. In cars, alcohol-blend fuels normally are consumed before they can absorb enough moisture to cause trouble, but boats often sit idle long enough for phase separation to take place. In addition, internal corrosion may take place during storage if alcohol has washed protective oil films from internal components.

No Lead Gasoline

Recent regulations by the U.S. Enviromental Protection Agency (EPA) and the Canadian government have required the removal of lead (anti-knock compound) from all gasoline by 1988 due to the lead emission in exhaust being a health hazard.

In order to maintain octane ratings, many gasoline manufacturers are adding ethyl alcohol (ethanol) or methyl alcohol (methanol) to the gasoline to replace the lead.

The use of any good grade unleaded regular or premium gasolines with a minimum posted octane rating [(A.K.I.) Anti-Knock Index] of 87, are satisfactory for use in your engine. In areas where unleaded regular or premium gasolines are not available, a good grade **leaded** regular with a minimum posted octane rating (A.K.I.) of 89 may be used.

GASOLINE/ALCOHOL BLENDS

Many new motor vehicle owner manuals are warning about the potential damage from using gasoline containing alcohol, especially **METHANOL.** They cite possible fuel system damage and performance problems. These are just two of the hazards that may be caused by alcohol. These same problems as well as the additional safety risk of fire and explosion from fuel system leaks apply to marine inboard engines. **METHANOL** is more severe in its bad effect than is **ETHANOL.** Alcohol is also more severe in older engines since newer engines have materials which are more resistant to alcohol.

Effects of Gasoline/Alcohol Blends on Marine Engines

Corrosion of metals may result from use of alcohol-gasoline blends. Portable or permanently installed fuel tanks of metal or fiberglass, fuel filters, fuel lines and float bowls may be affected by alcohol blended fuels. Many fiberglass fuel tanks are slowly dissolved by alcohol, leading immediately to filter and carburetor plugging and eventually to tank failure.

Alcohol containing fuels will absorb moisture from the air. At first, this moisture will remain in solution, but once the water content of the fuel has built up to about one-half of one percent, it will separate out, (phase separation) bringing the alcohol with it. This alcohol-water mixture settles to the bottom of the fuel tank and if this mixture gets into the engine, engines can be seriously damaged internally, as it may wash the protective film of oil off the bore of any cylinder that it enters. Before the engine can be restarted, it is necessary to remove the separated alcohol and water layer, flush out the fuel system with clean fuel and remove and dry the spark plugs.

BOAT/MOTOR STORAGE

When operating a MerCruiser engine on gasoline containing alcohol, storage of gasoline in the fuel tank for long periods of time should be avoided.

Long periods of storage, common to boats, create unique problems. In cars, gasoline/alcohol blend fuels normally are consumed before they can absorb enough moisture to cause trouble, but boats often sit idle long enough for phase separation to take place. In addition, internal corrosion may take place during storage if alcohol has washed protective oil films from internal components.

WINTER STORAGE

If boat is to be placed in winter storage, carburetors must be run dry at idle RPM. Permanent fuel tanks should be drained completely and Quicksilver Gasoline Stabilizer and Conditioner added to any fuel remaining in the tank. Portable fuel tanks should be emptied completely.

WARRANTY

Performance problems, fuel system or other damage resulting from the use of gasoline-alcohol blended fuels is not the responsibility of Mercury Marine and will not be covered under our warranty.

CONTINUING EVALUATIONS

The effects of gasoline blended with ETHANOL and METHANOL are still being evaluated by the United States Coast Guard, the National Marine Manufacturers Association (NMMA), Mercury Marine and other engine and boat manufacturers.

We have recommended pump posting of alcohol content of gasoline. Further we recommend using gasoline known not to contain any METHANOL or ETHANOL when possible.

TEST FOR ALCOHOL CONTENT IN GASOLINE

The following is an acceptable and widely used field procedure for the detection of alcohol in gasoline. (Outboard motors only; Test should be conducted **before the addition of oil** as the oil may obscure any change in separation level.) Use any small transparent bottle or tube that can be capped and is or can be provided with graduations or a mark at about 1/3 full. A pencil mark on a piece of adhesive tape may be used.

PROCEDURE

1. Fill the container with water to the mark.
2. Add fuel almost to fill the container, leaving some air space; then, cap the container. The proportions of fuel to water are not critical, but there should be 2-3 times as much fuel as water.
3. Shake container vigorously and allow it to sit **upright for up to about 3-5 minutes.** If the volume of water appears to have increased, alcohol is present. If you are not sure, there is no need for concern. If the dividing line between water and fuel becomes cloudy, use the middle of the cloudy band.

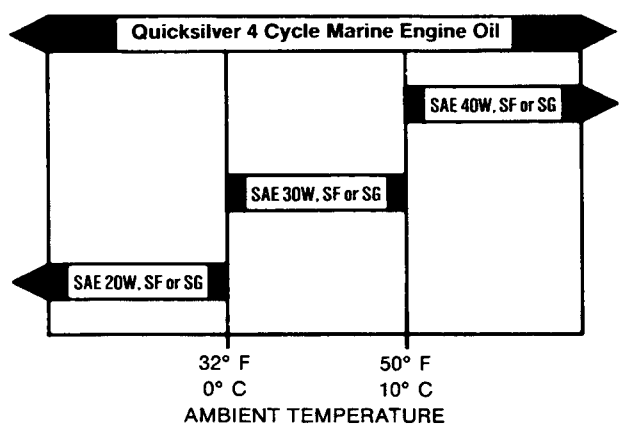
Crankcase Oil

To help obtain optimum engine performance and to provide maximum protection, we strongly recommend the use of Quicksilver 4-Cycle Marine Engine Oil. If not available, a good grade, straight weight, detergent automotive oil of correct viscosity, with an API classification of SF or SG, may be used.

The chart following is a guide to crankcase oil selection. Oil filter should always be changed with oil.

In those areas where recommended straight weight oil is not available, a multi-viscosity 20W-40 (SF or SG) or, as a second but less preferable choice, 20W-50 (SF or SG) may be used.

IMPORTANT: The use of non-detergent oils, multi-viscosity oils (other than 20W-40 or 20W-50), low quality oils or oils which contain solid additives specifically are not recommended.



Power Steering Fluid

Use Quicksilver Power Trim and Steering Fluid or automatic transmission fluid (ATF), Dexron, Dexron II.

Transmission Fluid

Borg-Warner - 10 wt. tractor hydraulic fluid meeting the c3/to-2 specification (preferably Mobil 423, Chevron, or Citgo).

Hurth - Automatic transmission fluid (ATF) Dexron II.

Coolant for Closed Cooling System

⚠CAUTION

Alcohol or Methanol base anti-freeze or plain water, are not recommended for use in fresh water section of cooling system at any time.

We recommend that the coolant section of Closed Cooling System be filled with Quicksilver Pre-Mixed Engine Coolant. In areas where the possibility of freezing DOES NOT exist, it is permissible to use a solution of rust inhibitor and water (mixed to manufacturer's recommendations).

MerCruiser V-8 engines can use any type of permanent anti-freeze or any brand anti-freeze solution that meets G.M. specification 1825M.

Maintaining Crankcase Oil Level

Overfilled Engine Crankcase

Overfilled crankcases (oil level being too high) can cause a fluctuation or drop in oil pressure and rocker arm "clatter," on MerCruiser engines. The over-full condition results in the engine crankshaft splashing and agitating the oil, causing it to foam (become aerated). The aerated oil causes the hydraulic valve lifters to "bleed down." This, in turn, results in rocker arm "clatter" and loss of engine performance, due to the valves not opening properly.

Care must be taken when checking engine oil level. Oil level must be maintained between the "ADD" mark and the "FULL" mark on the dipstick. To ensure that you are not getting "false reading," make sure the following steps are done before checking the oil level.

- Boat "at rest" in the water, OR
- If boat is on a trailer, raise or lower bow until the boat is setting at the approximate angle that it would be if setting "at rest" in the water.
- Allow sufficient time for oil to drain into the crankcase if engine has just been run or oil has just been added.

Checking Engine Oil Level/Filling

IMPORTANT: ENGINE CRANKCASE OIL MUST BE CHECKED AT INTERVALS SPECIFIED IN "MAINTENANCE CHART." It is normal for an engine to use a certain amount of oil in the process of lubricating and cooling the engine. Oil consumption will be higher on the 8.2 litre and 454/502 Magnums. These engines utilize forged (rather than cast) aluminum pistons to withstand the higher stresses created by their higher horsepower output. The forged pistons require increased piston-to-cylinder bore clearance to accommodate their higher thermo-expansion rate and thus, it is normal for some oil to be burnt-up in the combustion chambers. The amount of oil consumption is greatly dependant upon engine speed, with consumption being highest at wide-open-throttle and decreasing substantially as engine speed is reduced.

It is not uncommon for big block high performance engines to use up to 1 quart of oil in 1-5 hours if the engine is operated continuously at the upper end of the RPM range.

1. Stop engine and allow boat to come to a rest.
2. Allow oil to drain back into oil pan - approximately 5 minutes.
3. Remove dipstick. Wipe clean and reinstall. Push dipstick all-the-way into dipstick tube.
4. Remove dipstick and note the oil level.
5. Oil level must be between the "FULL" and "ADD" marks.
6. If oil level is below "ADD" mark, proceed to 7 and 8.
7. Remove oil filler cap from valve rocker arm cover.
8. Add required amount of oil to bring level up to, but not over, the "FULL" mark on dipstick.

Changing Oil and Filter

1. Start engine and run until it reaches normal operating temperatures.

IMPORTANT: Change oil when engine is warm from operation, as it flows more freely, carrying away more impuritites.

2. Stop engine.
3. Remove drain plug from oil pan.

NOTE: If drain plug is not accessible because of boat construction, oil may be removed thru dipstick tube, using a Quicksilver Crankcase Oil Pump. (See Quicksilver Accessory Guide.)

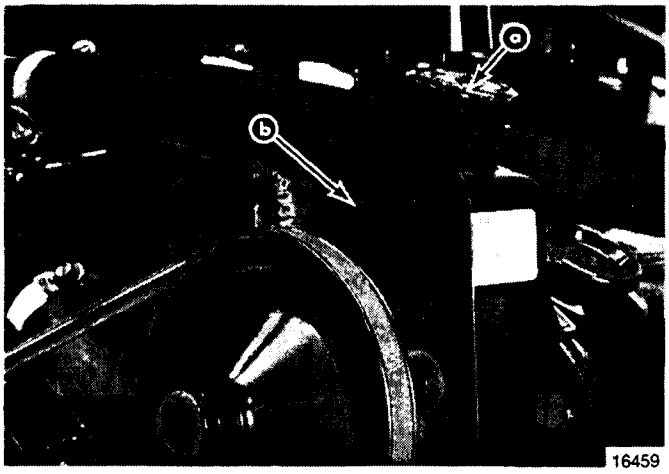
4. After oil has drained completley, reinstall drain plug and tighten securely.
5. Remove and discard oil filter and its sealing ring.

6. Coat sealing ring on new filter with engine oil, and install on engine. Tighten filter securely (following filter manufacturer's instructions). Do not overtighten.
7. Fill crankcase with oil.
8. Start engine, and check for leaks.

Maintaining Power Steering Pump Fluid Level

With Engine Warm

1. Stop engine and position drive unit so that it is straight back.
2. Remove fill cap/dipstick from Power Steering pump and note fluid level.



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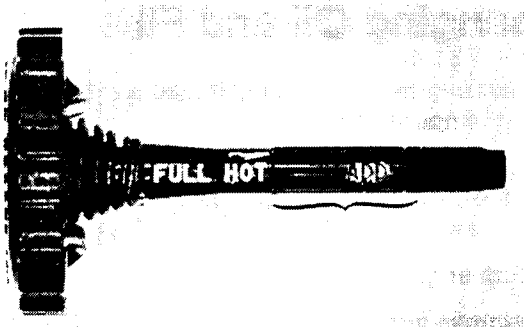
a - Fill Cap/Dipstick
b - Pump

3. Level should be between the "FULL HOT" mark and "ADD" mark on dipstick.



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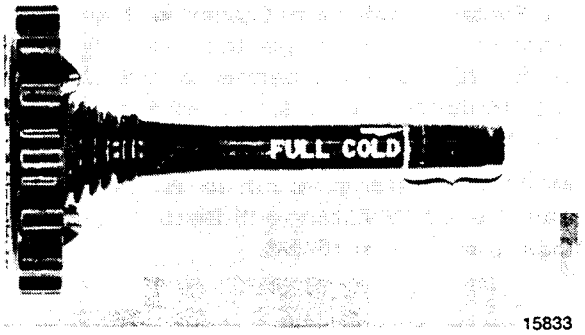
4. If level is below "ADD" mark, but fluid is still visible in pump reservoir, add required amount of Quicksilver Power Trim and Steering Fluid or automatic transmission fluid (ATF), Dexron, or Dexron II, thru fill cap opening, to bring level up to "FULL HOT" mark on dipstick - DO NOT OVERFILL.
5. If fluid is not visible in reservoir, a leak exists in the Power Steering system. Find cause and correct.

With Engine Cold

1. With engine stopped, position drive unit so that it is straight back.
2. Remove fill cap/dipstick from Power Steering pump and note fluid level.
3. Level should be between "FULL COLD" mark and bottom of dipstick.



15833

4. If level is below bottom of dipstick, but fluid is still visible in pump reservoir, add required amount of Quicksilver Power Trim and Steering Fluid or automatic transmission fluid (ATF), Dexron, or Dexron II, thru fill cap opening, to bring level up to "FULL COLD" mark on dipstick - DO NOT OVERFILL.
5. If fluid is not visible in reservoir, a leak exists in the Power Steering system. Find cause and correct.

Filling and Bleeding Power Steering System

IMPORTANT: Power Steering system must be filled exactly as explained, following, to be sure that all air is bled from the system. All air must be removed, or fluid in pump may foam during operation and be discharged from pump reservoir. Foamy fluid also may cause Power Steering system to become spongy, which may result in poor boat control.

1. With engine stopped, position drive unit so that it is straight back. Remove fill cap/dipstick from power steering pump. Add Quicksilver Power Trim and Steering Fluid or automatic transmission fluid (ATF), Dexron, or Dexron II as required, to bring level up to "FULL-COLD" mark on dipstick.

IMPORTANT: Use only Quicksilver Power Trim and Steering Fluid or automatic transmission fluid (ATF), Dexron, or Dexron II, in power steering system.

2. Turn steering wheel back-and-forth to end of travel in each direction several times; then, recheck fluid level and add fluid, if necessary.
3. Install vented fill cap.

⚠CAUTION

DO NOT operate engine without water being supplied to seawater pickup pump or pump impeller may be damaged and subsequent overheating damage to engine may result.

4. Start engine and run at fast idle (1000-1500 RPM) until engine reaches normal operating temperature. During this time, turn steering wheel back-and-forth to end of travel in each direction several times.
5. Position drive unit so that it is straight back and stop engine. Remove fill cap from pump. Allow any foam in pump reservoir to disperse; then, check fluid level and add fluid, as required, to bring level up to "FULL-HOT" mark on dipstick. Do not overfill. Reinstall fill cap securely.

IMPORTANT: Drive unit must be positioned straight back and Power Steering fluid must be hot to accurately check fluid level.

6. If fluid is still foamy (in Step 5), repeat Steps 4 and 5 until fluid does not foam and level remains constant.

Maintaining Closed Cooling Coolant Level

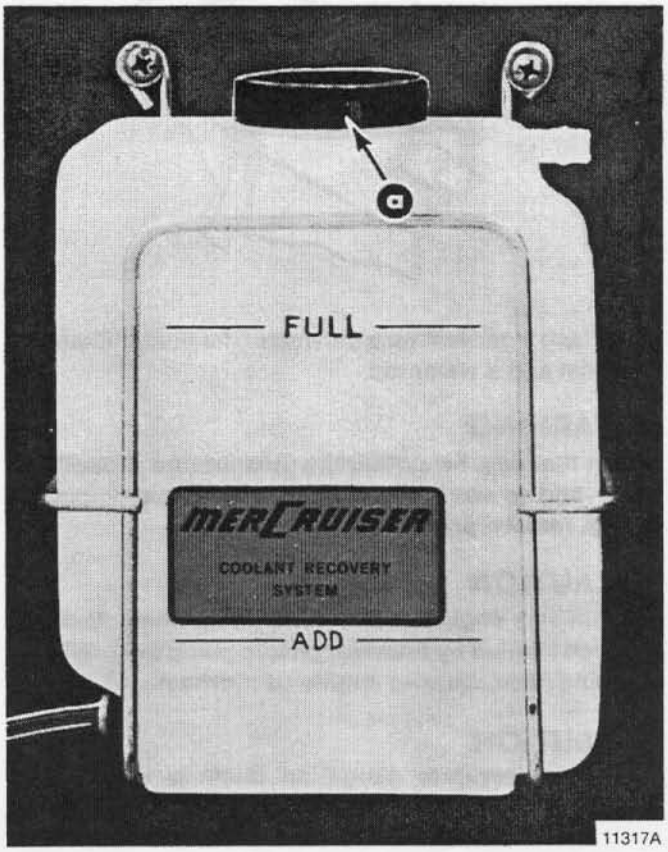
⚠WARNING

Allow engine to cool down before removing pressure cap. Sudden loss of pressure could cause hot coolant to boil and discharge violently. After engine has cooled down, turn cap 1/4-turn to allow any pressure to escape slowly; then, push down and turn cap all-the way off.

1. Coolant level in heat exchanger should be full (to bottom of filler neck).

IMPORTANT: When reinstalling pressure cap, be sure to tighten it until it contacts stop on filler neck.

2. Coolant level should be between the "ADD-FULL" marks on coolant recovery reservoir with the engine at normal operating temperature.



a - Filler Cap

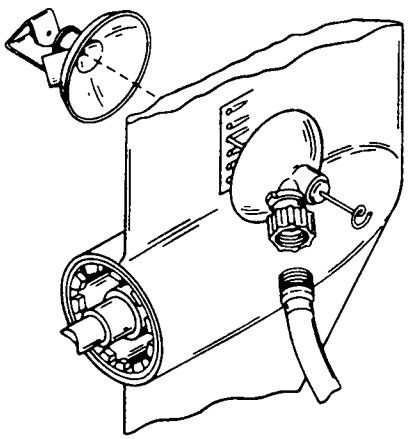
Flushing Cooling System

If engine is operated in salty, polluted, or mineral-laden water, flush cooling system (preferably after each use) to reduce corrosion and prevent the accumulation of deposits in the system. Thoroughly flush cooling system prior to storage.

MCM Stern Drive

BOAT OUT OF WATER

1. Install flushing attachment over water pick-up holes in gear housing as shown.



2. Attach a garden hose betweeen the flushing attachment and a water tap.

⚠WARNING

When flushing, be certain the area around propeller is clear, and no one is standing nearby. To avoid possible injury, remove propeller.

⚠CAUTION

Do not run engine above 1500 RPM when flushing. Suction created by seawater pickup pump may collapse flushing hose, causing engine to overheat.

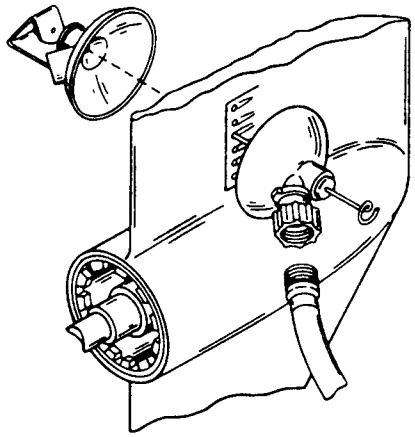
⚠CAUTION

Watch temperature gauge on dash to ensure that engine does not overheat.

3. Partially open water tap (approximately 1/2 maximum capacity). DO NOT use full water pressure.
4. Place remote control in neutral, idle speed position, and start engine.
5. Operate engine at idle speed in neutral for 10 minutes, or until discharge water is clear; then, stop engine.
6. Shut off water tap. Remove garden hose and flushing attachment.

BOAT IN WATER

1. Raise drive unit to full "Up" position.
2. Install flushing attachment over water pick-up holes in gear housing as shown.



3. Attach a garden hose betweeen the flushing attachment and a water tap.
4. Lower drive unit to full "In" position.

⚠CAUTION

Do not run engine above 1500 RPM when flushing. Suction created by seawater pickup pump may collapse flushing hose, causing engine to overheat.

⚠CAUTION

Watch temperature gauge on dash to ensure that engine does not overheat.

5. Partially open water tap (approximately 1/2 maximum capacity). DO NOT use full water pressure.
6. Place remote control in neutral, idle speed position, and start engine.
7. Operate engine at idle speed in neutral for 10 minutes, then stop engine.
8. Shut-off water tap.
9. Raise drive unit to full "Up" position.
10. Remove garden hose and flushing attachment.

MIE Inboard

⚠CAUTION

If cooling system is to be flushed with boat in the waters, water inlet valve (if so equipped) must be closed or water inlet hose must be disconnected and plugged, to prevent water from flowing into boat.

IMPORTANT: If a valve is to be installed for this purpose, valve used must have an internal cross-sectional area equal to or greater than water inlet hose to prevent restricting water flow during normal operation. A 1-1/4 in. (32mm) or larger brass ball valve or gate valve is recommended.

1. Remove inlet hose from seapump.

NOTE: If boat is left in water, shut off seacock or plug hose to prevent seawater from entering boat.

2. Using an adaptor, connect a garden hose from a water tap to seapump inlet.
3. Partially open water tap (approximately 1/2 maximum). DO NOT use full water pressure.
4. Place the remote control lever in neutral position and start engine.

⚠WARNING

When flushing, be certain the area around propeller is clear, and no one is standing nearby. To avoid possible injury, remove propeller.

⚠CAUTION

Do not run engine above 1500 RPM when flushing. Suction created by seawater pickup pump may collapse flushing hose, causing engine to overheat.

⚠CAUTION

Watch temperature gauge on dash to ensure that engine does not overheat.

5. Operate engine at idle speed in neutral for 10 minutes, or until discharge water is clear. Stop engine.
6. Shut off water tap. Remove garden hose and adaptor from pump inlet and reconnect water inlet hose. Be sure to tighten hose clamp securely.

⚠CAUTION

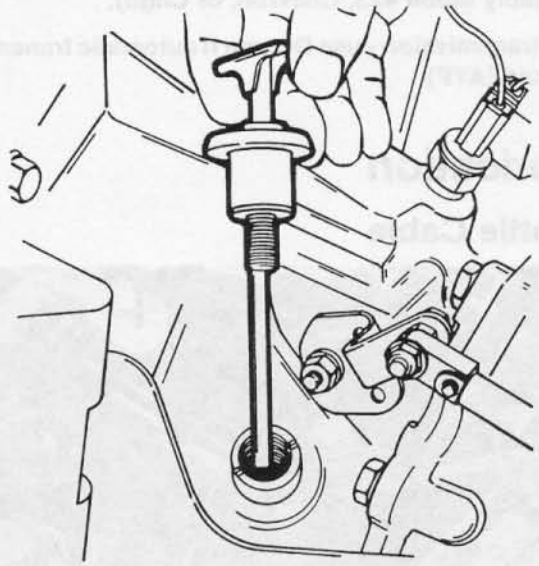
If boat is in the water, or is to remain in the water, seacock, if so equipped, must be left closed until engine is to be restarted to prevent water from flowing back into seawater cooling system. If boat is not fitted with a seacock, water inlet hose must be left disconnected and plugged to prevent water from flowing into cooling system and/or boat. As a precautionary measure, attach a tag to the ignition switch or steering wheel with the warning that the valve must be opened or the water inlet hose reconnected prior to starting the engine.

Maintaining Transmission Fluid Level

IMPORTANT: Be sure to push dipstick all-the-way down into dipstick tube when checking fluid level.

1. Remove dipstick to check transmission fluid level. Fluid level may be over the full mark because the cooler and lines have drained back into transmission.

   If fluid level is low, add the specified fluid, thru dipstick hole, until full.



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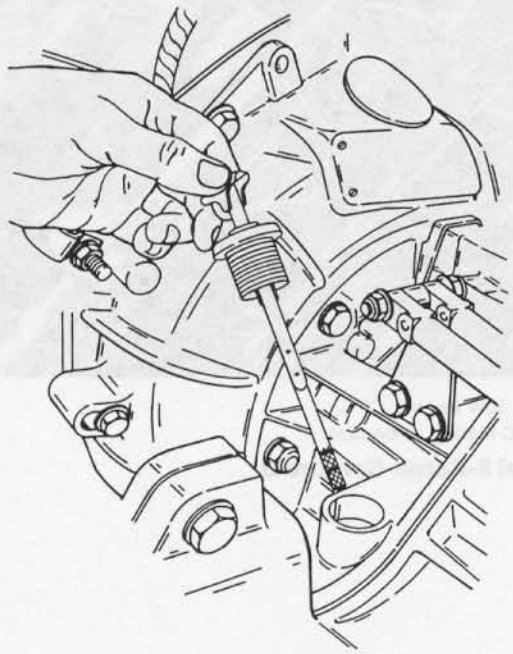
Borg-Warner



50199

Hurth

IMPORTANT: To accurately check fluid level, engine MUST BE run at 1500 RPM for 2 minutes immediately prior to checking level.

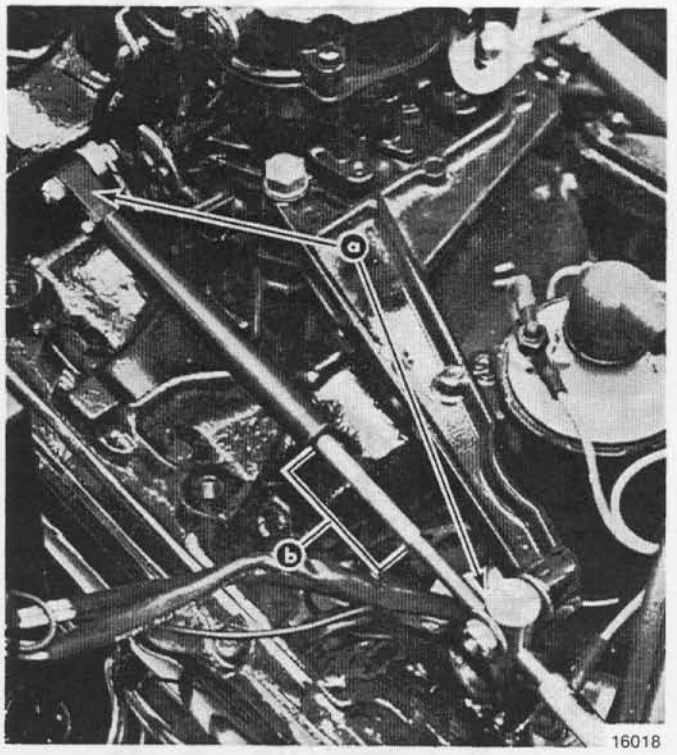
2. Start engine and run at 1500 RPM for 2 minutes to fill all circuits, lines, and cooler.
3. Stop engine and quickly check level before fluid drains back into transmission. Add if necessary.
4. If fluid level is extremely low, check transmission case, cooler, and hoses for leaks.

IMPORTANT: Borg-Warner transmission - use 10 wt. tractor hydraulic fluid meeting the c3/to-2 specification (preferably Mobil 423, Chevron, or Citgo).

Hurth transmission - use Dexron II automatic transmission fluid (ATF).

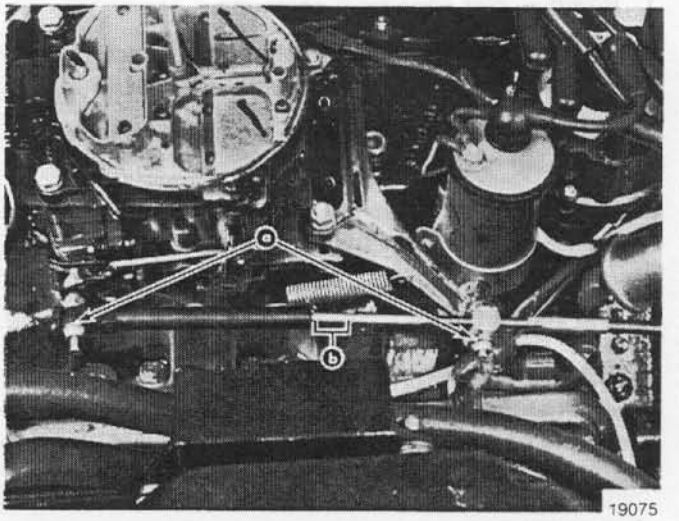
Lubrication

Throttle Cable



a - SAE 30W Engine Oil
b - 2-4-C Marine Lubricant

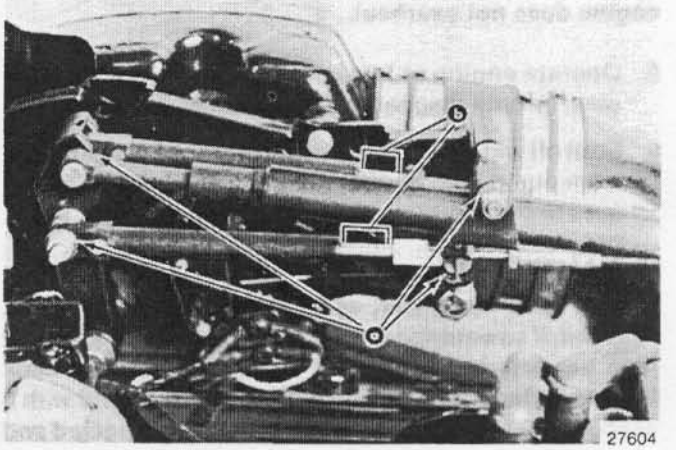
Typical 2-Barrel Carburetor



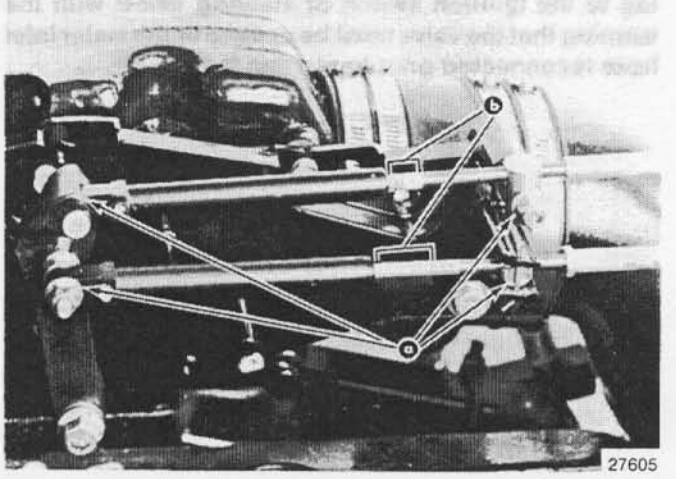
a - SAE 30W Engine Oil
b - 2-4-C Marine Lubricant

Typical 4-Barrel Carburetor

Shift Cable

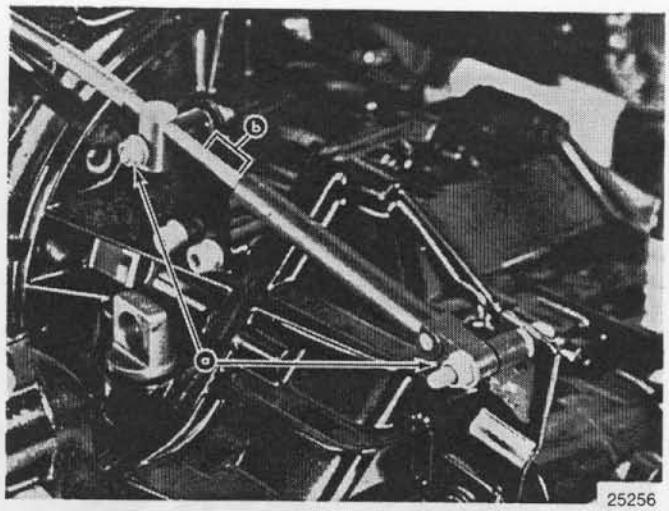


Alpha One

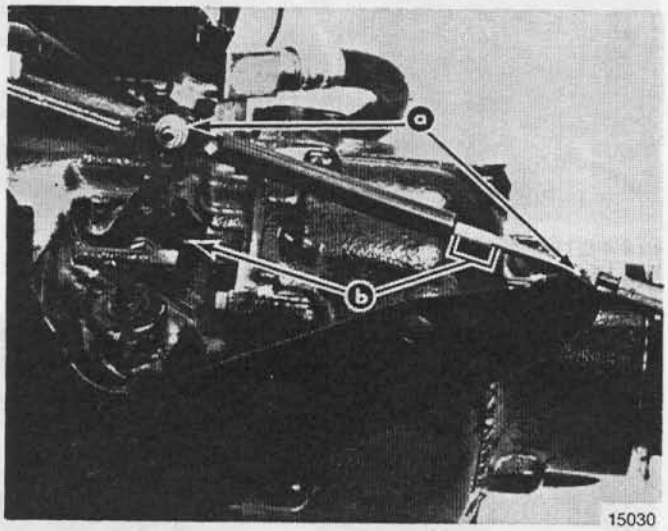


Bravo One and Two
MCM Models (Typical) Shift Cable

a - SAE 30W Engine Oil
b - 2-4-C Marine Lubricant



Hurth



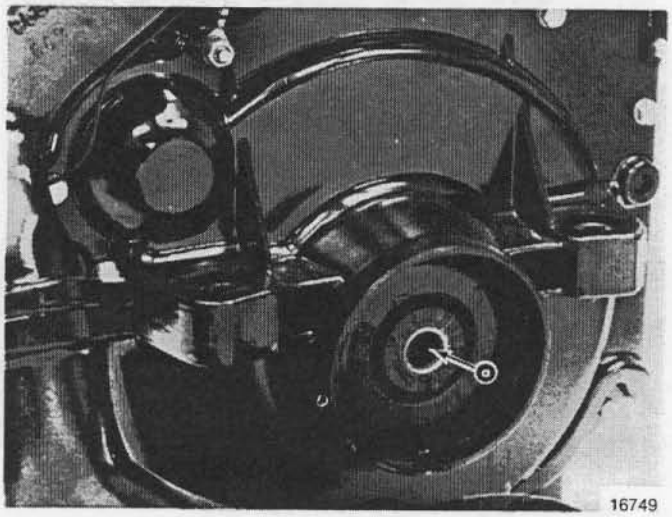
Borg-Warner

MIE Models (Typical) Shift Cable and Transmission Linkage

a - SAE 30W Engine Oil
b - 2-4-C Marine Lubricant

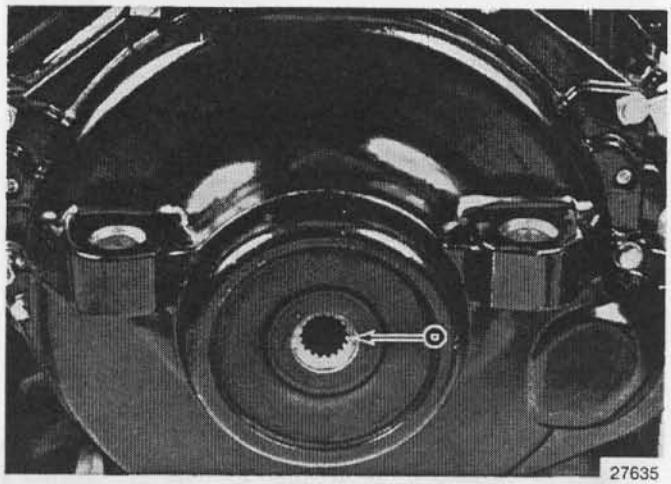
Engine Coupler/U-Joint Shaft Splines

NOTE: Refer to MerCruiser Stern Service Manual, for stern drive unit removal and installation.

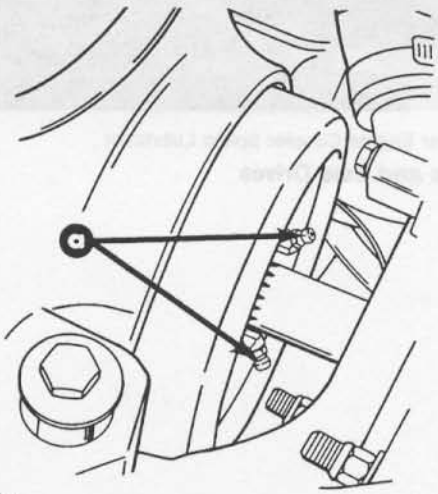


a - Quicksilver Engine Coupler Spline Lubricant

MCM Models with Alpha One Drive



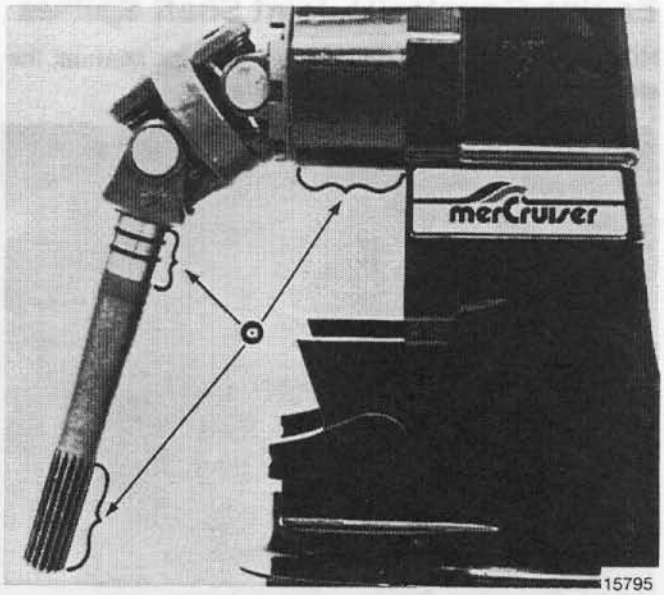
Early Style



Late Style

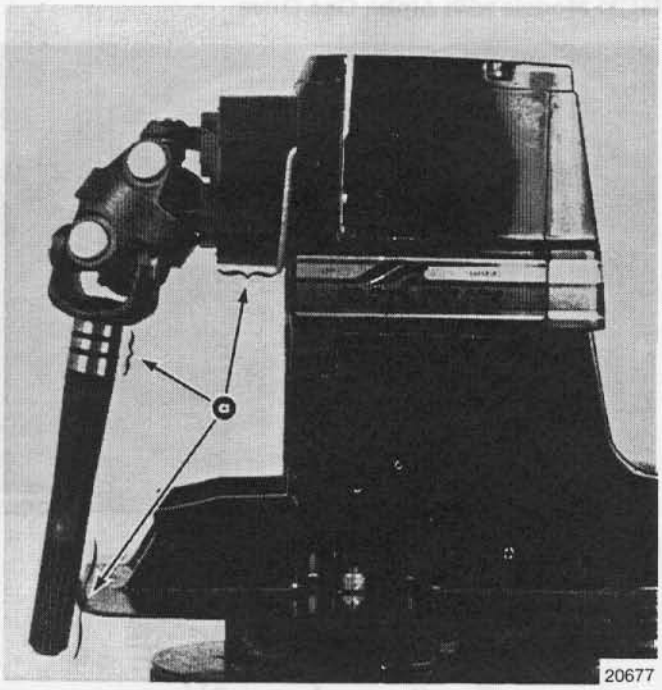
a - Quicksilver Engine Coupler Spline Lubricant

MCM Models with Bravo One and Two Drives



a - Quicksilver Engine Coupler Spline Lubricant

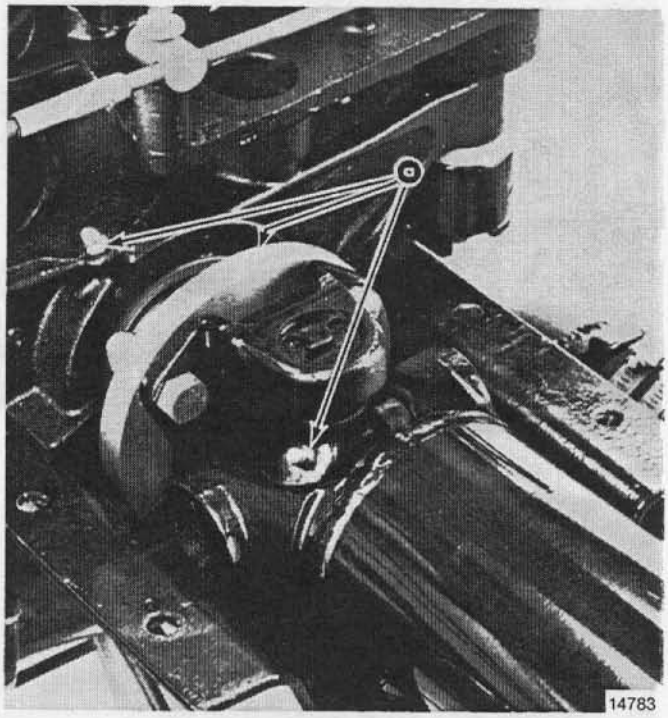
Alpha One Drive



a - Quicksilver Engine Coupler Spline Lubricant

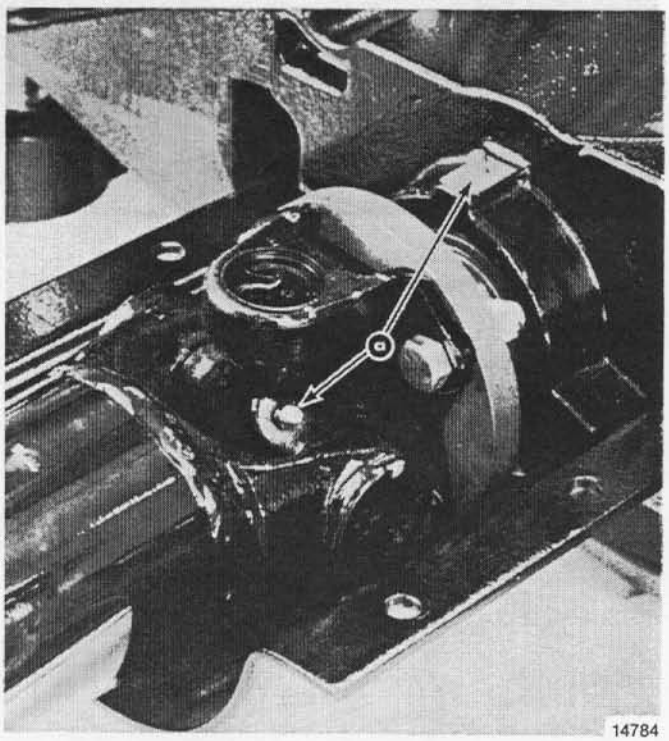
Bravo One and Two Drives

Drive Shaft Extension Models



a - 2-4-C Lubricant

Transom End



a - 2-4-C Marine Lubricant

Engine End

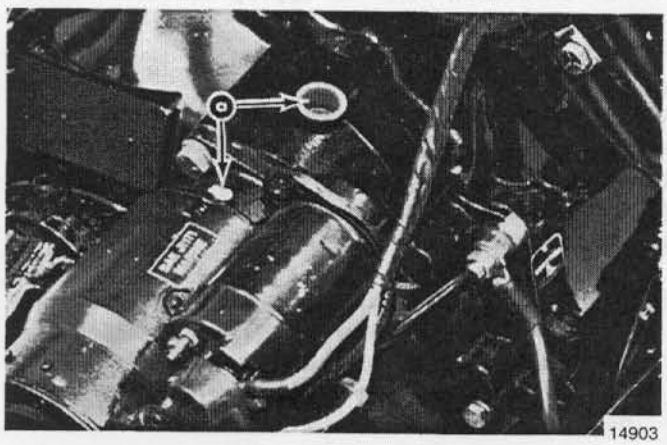
Starter Motor

⚠WARNING

When performing the following procedure, be sure to observe the following:

- **Be sure that engine compartment is well ventilated and that no gasoline vapors are present, to avoid the possibility of a fire.**
- **Be sure to ground coil hi-tension wire to block. Failure to ground coil wire may cause damage to ignition coil, in addition to being a safety hazard.**
- **Stay clear of all moving parts.**

IMPORTANT: Some 5.7 Ski Models do not require lubrication.



a - SAE 30W Engine Oil

Starter Motor Lubrication

MIE MODELS (IF SO EQUIPPED)

1. Remove ignition coil hi-tension wire from distributor cap tower and ground it to engine block with jumper wire. While cranking engine with starter motor, lubricate starter motor front bushing thru oil cover with Lubriplate Extra-Heavy Gear Shield or its equivalent. Reinstall coil hi-tension wire.
2. Remove plastic plug from flywheel housing. Lubricate starter motor shaft with Lubriplate Extra-Heavy Gear Shield thru hole in flywheel housing. Reinstall plastic plug.

Cold Weather or Extended Storage

Precautions

⚠WARNING

Be Careful while working on fuel system; gasoline is extremely flammable and highly explosive under certain conditions. Be sure that ignition key is "OFF" and do not smoke or allow sources of spark and/or open flames in the area.

⚠WARNING

To prevent a potential fire hazard, be sure that engine compartment is well ventilated and that there are no gasoline vapors present during starting or fogging of engine.

⚠CAUTION

DO NOT operate engine without cooling water being supplied to seawater pickup pump, or water pump impeller will be damaged and subsequent overheating damage to engine may result.

⚠CAUTION

Cooling System must be completely drained for storage, or trapped water may cause freeze and/or corrosion damage to engine. If engine has been exposed to freezing temperatures, the boat should be placed in a warm area before attempting to run engine or drain cooling system.

⚠CAUTION

If engine is equipped with Closed Cooling System, Closed Cooling section must be kept filled with a solution of ethylene glycol anti-freeze and water (mixed anti-freeze manufacturer's recommended proportions to protect engine to lowest temperature to which it will be exposed). Seawater section, however, must be drained completely.

⚠CAUTION

A discharged battery can be damaged by freezing.

Layup

NOTICE

Refer to "Precautions", in this section, BEFORE proceeding.

1. Fill fuel tank(s) with fresh gasoline that does not contain alcohol and a sufficient amount of Quicksilver Gasoline Stabilizer and Conditioner to treat the gasoline.

IMPORTANT: If boat is to be placed in storage (with fuel containing alcohol in fuel tanks), carburetors must be run dry at idle RPM. Fuel tanks should be drained completely and Quicksilver Gasoline Stabilizer and Conditioner added to any fuel remaining in the tank. Also, refer to "Fuel Requirements"; see Table of Contents.

2. Replace all fuel filters.
3. Start engine and check for fuel leaks.
4. Run engine sufficiently to bring it up to normal operating temperature; shut off engine and change oil and filter.
5. If boat has been operated in salty, polluted or mineral-laden waters, flush cooling system.

6. Remove flame arrestor assembly and restart engine. While operating engine at fast idle (1000-1500 RPM), fog internal surfaces of induction system and combustion chambers by squirting approximately 8 ounces (227 grams) of Quicksilver Storage Seal or SAE 20W engine oil into carburetor bores. Stall engine by squirting last 2 ounces (57 grams) of Storage Seal or oil rapidly into carburetor. Turn ignition to "OFF."
7. Close fuel shut off valve, if so equipped.
8. Clean flame arrestor and crankcase ventilation hoses and reinstall.
9. Lubricate all items outlined in "Lubrication."
10. Drain seawater section of cooling system. Refer to SECTION 6A for instructions appropriate to your engine.
11. Closed Cooling System Models, test coolant to ensure that it will withstand lowest temperature expected during storage.
12. Service batteries. Refer to manufacturer's instructions.
13. Clean outside of engine and repaint any areas required with Quicksilver Primer and Spray Paint. After paint has dried, spray Quicksilver Corrosion and Rust Preventive Type II or wipe down with Quicksilver Storage Seal or SAE 20W engine oil.
14. For drive unit, refer to appropriate Stern Drive Manual.

Recommissioning

NOTICE

Refer to "Precautions", in this section, BEFORE proceeding.

1. Check that all cooling system hoses are connected and tight and all petcocks and drain plugs are in and tight.
2. Inspect all drive belts.
3. Perform all lubrication and maintenance specified for completion "At Least Once Each Year" in maintenance chart, except items which were performed at time of engine layup.
4. For drive unit, refer to appropriate stern drive manual.

⚠CAUTION

When installing battery (in next step), be sure to connect negative (grounded) battery cable to negative (-) battery terminal and positive battery cable to positive (+) terminal. If battery cables are reversed, damage to electrical system WILL result.

6. Install fully-charged battery. Clean battery cable clamps and terminals and reconnect cables. Be sure to tighten clamps securely. Apply a thin coat of petroleum base grease to clamps and terminals to help retard corrosion.
7. Start engine and closely observe instrumentation to ensure that all systems are functioning properly.
8. Carefully inspect entire engine for fuel, oil, water and exhaust leaks.
9. Check fuel pump sight tube.
10. Check steering system and shift and throttle control for proper operation.

TROUBLESHOOTING

1

C

CAUSE	SPECIA
1. Moisture on ignition components	1. Distributor cap or spi
2. Battery, electrical connections, damaged wiring	
3. Ignition switch	
4. Shift interruptor switch	5. Disconnect tachom
5. Shorted tachometer	
6. Ignition timing	7. Fouled, burned, cr
7. Spark plugs	8. Faulty insulation,
8. Spark plug wires	
9. Cracked or dirty distributor cap	10. Check compone
10. Faulty ignition components	11. Synchronizers m (parallel circuit)
11. Engine synchronizer (if equipped) hooked up in series on ...nition wire (dual engines only)	

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Refer to "Precautions," BEFORE proceeding with troubleshooting.

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Precautions

⚠WARNING
Always disconnect battery cables from battery BEFORE working on fuel system to prevent fire or explosion.

⚠WARNING
Be careful when cleaning flame arrestor and crankcase ventilation hose; gasoline is extremely flammable and highly explosive under certain conditions. Be sure that ignition key is "OFF." DO NOT smoke or allow sources of spark or open flame in area when cleaning flame arrestor and crankcase ventilation hose.

⚠WARNING
Be careful when changing fuel system components; gasoline is extremely flammable and highly explosive under certain conditions. Be sure that ignition key is "OFF." DO NOT smoke or allow sources of spark or flame in the area while changing fuel filter. Wipe up any spilled fuel immediately.

⚠WARNING
Make sure no fuel leaks exist, before closing engine hatch.

⚠CAUTION
DO NOT operate engine without cooling water being supplied to water pickup holes in gear housing, or water pump impeller will be damaged and subsequent overheating damage to engine may result.

⚠CAUTION
DO NOT operate engine without water being supplied to seawater pickup pump on engine, or pump impeller may be damaged and subsequent overheating damage to engine may result. Engine may be operated with boat out of water, if instructions, under "Running Engine with Boat Out of Water," following are completed.

⚠WARNING
When running engine with boat out of water, be certain that area in vicinity of propeller is clear and that no person is standing nearby. As a precautionary measure, it is recommended that the propeller be removed.

⚠CAUTION
DO NOT run engine above 1500 RPM, as suction created by seawater pickup pump may collapse water supply hose and cause engine to overheat.

⚠WARNING
Be sure that engine compartment is well ventilated and that no gasoline vapors are present to prevent the possibility of a FIRE.

⚠WARNING
DO NOT leave helm unattended while performing idle speed adjustment.

Used Spark Plug Analysis

Use the following illustrations for determining serviceability of spark plug. Spark plug condition also can suggest a variety of possible engine malfunctions and, therefore, can indicate needed engine repairs. When old plugs are replaced, replace entire set. Perform plug service only on those plugs suitable for additional service, using the following procedures:

A. Remove any oil deposits with solvent and dry plugs thoroughly.

B. Open electrode gap wide enough to permit cleaning and filing.

C. Remove combustion deposits from firing end of spark plug with a plug cleaner. Blow off with compressed air to remove abrasives.

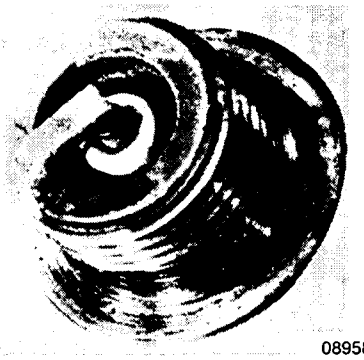
D. File electrode surfaces to restore clean, sharp edges. Again remove filings with compressed air.

E. Reset gap to specifications by bending only side electrode with proper tool.

Spark Plug Analysis

NORMAL CONDITION

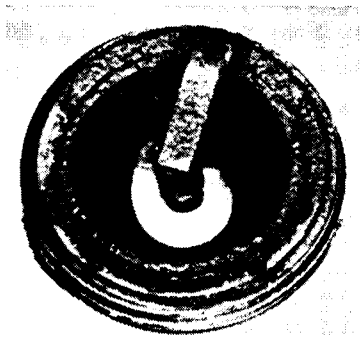
Few deposits are present and probably will be light tan or gray in color. This plug shows that plug heat range is compatible with engine, and engine is electrically and mechanically in good running condition. With proper plug servicing (clean, file and regap), this plug can be reinstalled with good results.



08958

CHIPPED INSULATOR

Chipped insulator usually results from careless plug regapping. Under certain conditions, severe detonation also can split insulator firing ends. Plug must be replaced.



08957

WET FOULING (OIL DEPOSITS)

Plug becomes shorted by excessive oil entering combustion chamber, usually in engine with many hours of operation. Worn piston rings, cylinder walls, valve guides or valve stem seals are causes of oil entering combustion chamber. Only engine repairs will permanently relieve oil wet fouling.

IMPORTANT: New engines or recently overhauled engines may wet foul plugs before normal oil control is achieved with proper break-in procedures. Such fouled plugs may be serviced (clean, file and regap) and reinstalled.

08958

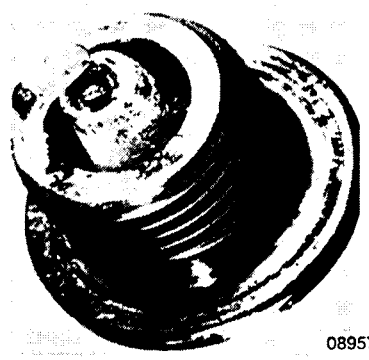
COLD FOULING

Dry, black deposits indicate rich fuel mixture or weak ignition. Clogged flame arrestor, flooding carburetor, sticky choke or weak ignition components all are probable causes. If, however, only one or two plugs in set are fouled, check for sticking valves or bad ignition leads. After correcting cause, service (clean, file and regap) plugs and reinstall.

08958

OVERHEATING

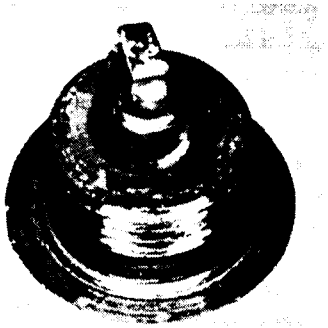
Insulator is dull white or gray and appears blistered. Electrodes are eroded and there is an absence of deposits. Check that correct plug heat range is being used. Also check for over-advanced ignition timing, cooling system malfunction, lean fuel/air mixtures, leaking intake manifold or sticking valves. Replace spark plugs.



08957

HIGH SPEED GLAZING

Insulator has yellowish, varnish-like color, indicating that temperatures suddenly have risen, usually during hard, fast acceleration under heavy load. Normal deposits do not get a chance to blow off. Instead, they melt and form a conductive coating. Replace plugs. If condition re-occurs, use colder heat range plug and service plugs more frequently.



08958

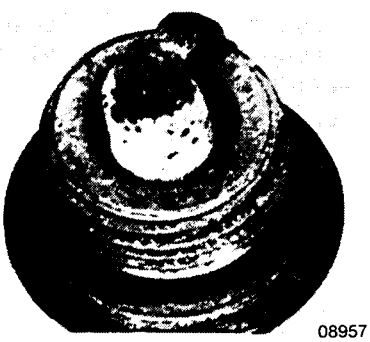
SCAVENGER DEPOSITS

Powdery white or yellow deposits are built up on shell, insulator and electrodes. This is normal appearance with certain branded fuels. Accumulation on ground electrode and shell areas may be unusually heavy, but may be easily chipped off. Plugs can be serviced (clean, file and regap) and reinstalled.

08958

PRE-IGNITION DAMAGE

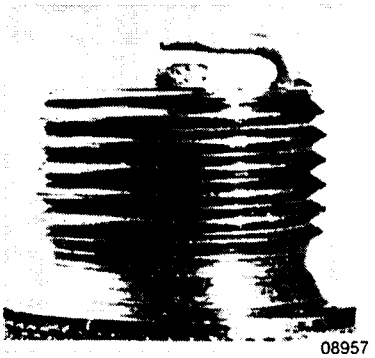
Pre-ignition damage is caused by excessive high temperatures. Center electrode melts first, followed by ground electrode. Normally, insulators are white but may be dirty if plug has been misfiring. Check for correct plug heat range, advanced ignition timing, lean fuel mixture, incorrect fuel used, malfunctioning cooling system, leaking intake manifold or lack of lubrication.



08957

REVERSED COIL POLARITY

Concave erosion of ground electrode is an indication of reversed polarity. Center electrode will show only normal wear. Engine will misfire and idle rough. To correct, reverse primary coil leads. Replace spark plugs.



08957

SPLASHED DEPOSITS

Spotted deposits, which sometimes occur after long delayed tune-up, accumulate after a long period of misfiring. When normal combustion temperatures are restored, upon installation of new plugs, deposits loosen from top of piston and head and are thrown against hot insulator. Clean and service plugs and reinstall.

08958

MECHANICAL DAMAGE

Mechanical damage to spark plug firing end is caused by foreign object in combustion chamber. Because of valve overlap, small objects can travel from one cylinder to another. Check all cylinders, intake manifold and exhaust manifold to prevent further damage.

08957

IMPORTANT: When working on engine, spark plug holes and carburetor throat should be kept covered to prevent foreign objects from entering combustion chamber.

Poor Boat Performance and/or Poor Maneuverability

SYMPTOM	CAUSE
1. Bow too low	1. A. Improper drive unit trim angle B. Improper weight distribution C. Boat is underpowered D. Permanent or power hook in boat bottom E. False bottom full of water F. Improperly adjusted trim tabs (after planes)
2. Bow too high	2. A. Improper drive unit trim angle B. Propeller pitch too great C. Dirty boat bottom (marine growth) D. Poor running engine E. Improper weight distribution F. Rocker in boat bottom G. False bottom full of water H. Improperly adjusted trim tabs (after planes)
3. Propeller ventilating	3. A. Drive unit installed too high on transom B. Dirty or rough boat bottom C. Damaged propeller; pitch too small; diameter too small D. Keel located too close to propeller or too deep in the water E. Water pick-up or accessories located too close to propeller F. Hook in boat bottom G. Propeller plugged up with weeds

Improper Full Throttle Engine RPM

RPM TOO HIGH

CAUSE	SPECIAL INFORMATION
1. Propeller	1. Damaged; pitch too low; diameter too small; propeller hub slipping
2. Boat	2. Water pick-up or accessories mounted too close to propeller (ventilation); keel located too close to propeller and/or too deep in the water (ventilation). Drive installed too high on transom; wrong gear ratio.
3. Operation	3. Unit trimmed out too far.
4. Engine coupler slipping	

RPM TOO LOW

CAUSE	SPECIAL INFORMATION
1. Propeller	1. Damaged; pitch too great; diameter too great.
2. Boat	2. Dirty or damaged bottom; permanent or power hook in bottom; false bottom full of water. Drive installed too low on transom; wrong gear ratio.
3. Operation	3. Unit trimmed in too far

Engine Cranks Over But Will Not Start or Starts Hard

IMPORTANT INFORMATION

1. First, determine which engine system is causing the problem. To make an engine run, basic components - fuel, spark (ignition), and compression are required. If all three components are present, the engine should run. If any one of the three are missing, weak, or arriving at the wrong time the engine will not run.
2. Determine if there is fuel present by looking down the carburetor venturi while actuating throttle. There should be a stream of fuel coming out of the accelerator pump nozzles if the carburetor has fuel.
3. Check ignition system operation. Remove coil wire from tower on distributor cap. Hold coil wire near ground and check for spark while cranking engine over. Repeat procedure with spark plug wires. If there is spark at the spark plug wires, remove the spark plugs and make sure they are correct type and heat range, and not fouled or burned.
4. Run a compression check on engine to make sure the engine is mechanically OK.

CONVENTIONAL IGNITION (NO SPARK)

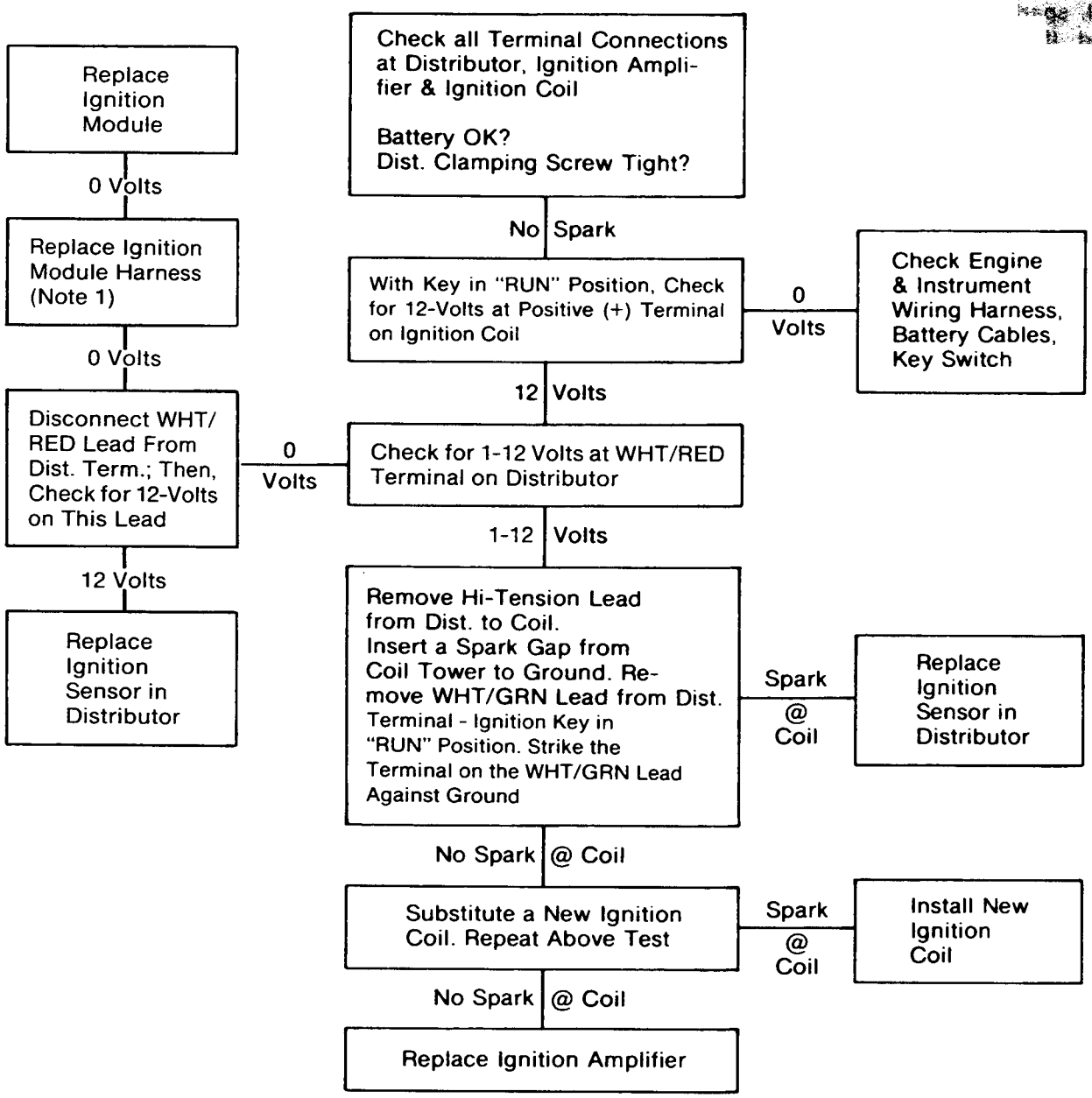
CAUSE	SPECIAL INFORMATION
1. Moisture on ignition components	1. Distributor cap or spark plug leads arcing
2. Battery, electrical connections, damaged wiring	
3. Ignition switch	3. May run in start position and lose spark in the run position.
4. Shift interruptor switch (Alpha One Models Only)	
5. Shorted tachometer	5. Disconnect tachometer and try again.
6. Ignition timing	6. May crank over hard, backfire, or try to run backwards
7. Faulty ignition resistor wire or bypass wire	
8. Ignition points improperly gapped, burned or dirty	
9. Spark plugs	9. Fouled, burned, cracked porcelain
10. Spark plug wires	10. Faulty insulation, broken wires
11. Cracked or dirty distributor cap or rotor	
12. Coil	
13. Condenser	

THUNDERBOLT IV (HEI) IGNITION (NO SPARK)

CAUSE	SPECIAL INFORMATION
1. Moisture on ignition components	1. Distributor cap or spark plug wires arcing
2. Battery, electrical connections, damaged wiring	
3. Ignition switch	
4. Shift interruptor switch (Alpha One Models Only)	
5. Shorted tachometer	5. Disconnect tachometer and try again
6. Ignition timing	
7. Spark plugs	7. Fouled, burned, cracked porcelain
8. Spark plug wires	8. Faulty insulation, broken wires
9. Cracked or dirty distributor cap	
10. Faulty ignition components	10. Check components
11. Engine synchronizer (if equipped) hooked up in series on purple ignition wire (dual engines only)	11. Synchronizers must be hooked up directly at coil terminal (parallel circuit)

Testing Thunderbolt HEI System

⚠WARNING
Be sure that engine compartment is well ventilated and that there are no gasoline vapors present during the following test - to prevent a potential fire hazard.



NOTE 1: Early, large ignition modules did not have a replaceable wiring harness.

FUEL SYSTEM RICH

CAUSE	SPECIAL INFORMATION
1. Warm engine carburetor percolation	1. Fuel boils out of float bowl when shut off and warm. Floods intake manifold.
2. Clogged flame arrestor	
3. Automatic choke not opening	
4. Float adjustment	
5. Float leaks or is saturated with fuel	
6. Needle and seat leaking	
7. Carburetor gaskets leaking	
8. Excessive fuel pump pressure	8. Unseats needle and seat
9. Cracked or porous carburetor body	

FUEL SYSTEM LEAN

CAUSE	SPECIAL INFORMATION
1. Empty fuel tank	
2. Fuel shut off valve closed (if equipped)	
3. Anti-siphon valve stuck closed (if equipped)	
4. Vapor lock	4. Engine will not start after warm engine shut down
5. Automatic choke	5. Stuck open, wrong adjustment
6. Fuel tank vent plugged	6. Engine will start initially. After a short time of running, engine will stall and will not restart for a period of time. Can varify it is a vent problem by running engine with filler cap loose. Fill cap will act as a vent.
7. Air leak on suction side of fuel sytem	7. Sucks air into fuel system reducing fuel volume
8. Plugged or pinched fuel line	
9. Fuel pump	9. Low pump pressure

MISCELLANEOUS

CAUSE	SPECIAL INFORMATION
1. Low grade or stale fuel	
2. Water in fuel	
3. Vacuum leak	
4. Low compression	4. Worn valves, rings, cylinder, or head gasket
5. valve timing incorrect	5. Timing chain or gears jumped or improperly installed

Engine Will Not Crank Over

CAUSE	SPECIAL INFORMATION
1. Control lever not in neutral position	
2. Battery charge low; damaged wiring; loose electrical connections	
3. Circuit breaker tripped	
4. Ignition switch	
5. Slave solenoid	
6. Faulty neutral start safety switch	6. Open circuit
7. Starter solenoid	
8. Starter motor	

Charging System Inoperative

CAUSE	SPECIAL INFORMATION
1. Loose or broken drive belt	
2. Engine RPM too low on initial start	2. Rev engine to 1500 RPM
3. Loose or corroded electrical connections	
4. Faulty ammeter or battery gauge	4. Best way to test is to replace gauge
5. Battery will not accept charge	5. Low electrolyte, failed battery
6. Faulty alternator or regulator	
7. Refer to "Section 4, Part C" for complete "Charging System" diagnosis procedures.	

NOISY ALTERNATOR

CAUSE	SPECIAL INFORMATION
1. Loose mounting bolts	
2. Drive belt	2. Worn, frayed, loose
3. Loose drive pulley	
4. Worn or dirty bearings	
5. Faulty diode trio or stator	

Instrumentation Malfunction

CAUSE	SPECIAL INFORMATION
1. Faulty wiring, loose or corroded terminals	
2. Bad key switch	2. Test, as outlined in "Section 4, Part D"
3. Faulty gauge	3. Test, as outlined in "Section 4, Part D"
4. Faulty sender	4. Test, as outlined in "Section 4, Part D"

Radio Noise

CAUSE	SPECIAL INFORMATION
1. A "popping" noise that will increase with engine RPM. Noise will stop as soon as engine is turned off.	1. Ignition System - wrong spark plugs; cracked distributor cap; cracked coil tower; leaking spark plug wires; moisture on ignition components.
2. "High pitched whine" in the radio	2. Alternator - poor brush contact on the slip rings
3. A "hissing or crackling" noise when instruments are jarred with ignition on	3. Instrumentation - loose connections, or antennae wire 3. routed too close to instruments
4. Varying unexplained noises	4. Accessories - bilge pump, bilge blower; fish finder, depth locator; cabin heater motor, etc. Disconnect one at a time until noise disappears.

Poor Fuel Economy

CAUSE	SPECIAL INFORMATION
1. Fuel leaks	
2. Operator habits	2. Prolonged idling; slow acceleration; failure to cut back on throttle once boat is on plane; boat overloaded; uneven weight distribution
3. Engine laboring	3. Bent, damaged, or wrong propeller. Water test boat for proper operating RPM at WOT.
4. Clogged flame arrestor	
5. Engine compartments sealed too tight	5. Not enough air for engine to run properly
6. Boat bottom	6. Dirty (marine growth), hook, rocker
7. Carburetor	7. Idle mixture settings, accelerator pump adjustment, linkage binding, choke adjustment, carburetor flooding over, main fuel jets
8. Improper fuel	
9. Crankcase ventilation system not working	
10. Engine needs tune-up	
11. Engine running too cold or too hot	
12. Plugged or restricted exhaust	
13. Engine	13. Low compression

Carburetor Malfunctions

SYMPTOM	CAUSE
1. Flooding	1. A. Needle and seat B. Float adjustment C. Saturated float D. Gaskets leaking E. Cracked fuel bowl F. Fuel percolation G. Automatic choke
2. Rough idle	2. A. Idle RPM too low B. Idle mixture screws C. Idle passages dirty D. Throttle valves not closing E. Engine flooding F. Vacuum leak G. Throttle body heat passages plugged
3. Hesitation or acceleration flatness	3. A. Accelerator pump B. Leaking gaskets C. Automatic choke D. Power piston or power valve E. Throttle valves F. Throttle body heat passages plugged G. Main metering jets H. Float adjustment I. Secondary air valve wind-up
4. Engine surges	4. A. Main metering jets B. Leaking gaskets C. Float adjustment D. Saturated float E. Power piston or valve F. Throttle valves
5. Low top speed or lack of power	5. A. Power piston or valve B. Float adjustment C. Main metering jets D. Leaking gaskets
6. Poor cold engine operation	6. A. Idle RPM too low B. Idle mixture screws C. Throttle valves D. Automatic choke E. Engine flooding
7. Engine stalls	7. A. Idle RPM too low B. Idle mixture screws C. Engine flooding D. Automatic choke E. Dirt in carburetor F. Accelerator pump G. Leaking gaskets
8. Hard starting	8. Refer to "Engine Starts Hard"

Engine Runs Poorly At Idle

CAUSE	SPECIAL INFORMATION
1. Clogged flame arrestor	
2. Improper idle fuel mixture adjustment	
3. Moisture on ignition components	3. Cap or spark plug wires arcing
4. Water in fuel	
5. Low grade or stale fuel	
6. Incorrect ignition timing	
7. Automatic choke	
8. Spark plugs	8. Fouled, burned, cracked porcelain
9. Incorrect point gap, burned or pitted points	
10. Spark plug wires	10. Insulation break down, wires broken
11. Defective coil or condenser	
12. Cracked or dirty distributor cap	
13. Incorrect float level	
14. Dirty carburetor	
15. Vacuum leak	15. Leak at manifold or carburetor base
16. Incorrect fuel pump pressure	16. Too low - can't supply the carburetor Too high - unseats the needle and seat
17. Low compression	17. Also check for blown head gasket
18. Loose or worn distributor	18. Timing and/or dwell changes
19. Water leaking into cylinders	19. Head gasket, exhaust manifold, cracked head or valve seat
20. Loose or broken engine mounts	

Engine Acceleration Is Poor

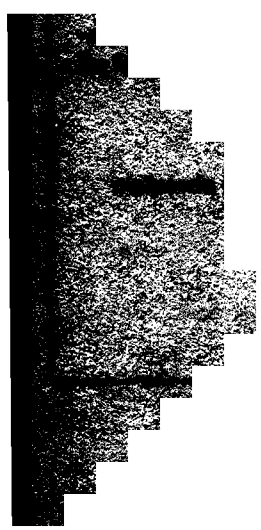
CAUSE	SPECIAL INFORMATION
1. Also refer to "Poor Boat Performance"	1. See "Index"
2. Idle mixture screws	
3. Air valve spring out of adjustment	3. Rochester 4 barrel carburetor only
4. Incorrect ignition timing	
5. Incorrect distributor or amplifier advance curve	5. Refer to Section 4, Part B
6. Accelerator pump	6. Check for stream of raw fuel from accelerator pump discharge nozzle, when opening throttle with engine shut off
7. Cracked or dirty distributor cap or rotor	
8. Vacuum leak	8. Intake manifold or carburetor base
9. Spark plugs	9. Fouled, burned; wrong heat range; cracked porcelain
10. Incorrect point gap, dirty or burned points	
11. Float adjustment	
12. Dirty carburetor	
13. Low compression	

Engine Runs Poorly At High RPM

CAUSE	SPECIAL INFORMATION
1. Also refer to "Poor Boat Performance"	1. See "Table of Contents"
2. Crankcase over-filled with oil	2. Check oil level with boat at rest in the water. Refer to Section 1, Part B
3. Anti-siphon valve (if equipped)	3. Restricting fuel supply
4. Plugged fuel tank vent	
5. Fuel supply	5. Refer to "Carburetor Malfunctions." (See "Table of Contents")
6. Ignition timing	
7. Low grade of fuel or water in the fuel	
8. Spark plugs	8. Fouled, burned, cracked porcelain, incorrect heat range
9. Spark plug wires	9. Poor insulation, broken wires
10. Distributor cap or rotor	10. Dirty or cracked
11. Coil	
12. Distributor	12. Points, condenser, worn cam, excessive play in shaft
13. Engine overheating	13. Refer to "Engine Over Heats" (See "Table of Contents")
14. Low compression	14. Worn valves, rings, cylinders, etc.
15. Restricted exhaust	

Troubleshooting with Vacuum Gauge

READING	CAUSE
1. Steady reading between 15-21 inches at idle RPM	1. Normal
2. Extremely low reading, but steady at idle RPM	2. Vacuum leak; incorrect timing; under powered boat; faulty boat bottom
3. Fluctuates between high and low at idle RPM	3. Blown head gasket between 2 adjacent cylinders
4. Fluctuates 4 or 5 inches very slowly at idle RPM	4. Carburetor needs adjustment; spark plug gap too narrow; valves are sticking
5. Fluctuates rapidly at idle, steadies as RPM is increased	5. Valve guides are worn
6. Continuously fluctuates between low and normal reading at regular intervals at idle RPM	6. Burned or leaking valve



Engine Noise

IMPORTANT INFORMATION

No definite rule or test will positively determine source of engine noise; therefore, use the following information only as a general guide to engine noise diagnosis.

1. Use a timing light to determine if noise is timed with engine speed or one-half engine speed. Noises timed with engine speed, are related to crankshaft, rods, pistons, piston pins, and flywheel. Noises timed to one-half engine speed are valve train related.
2. The use of a stethoscope can aid in locating a noise source; however, because noise will travel to other metal parts not involved in the problem, caution must be exercised.
3. If you believe noise is confined to one particular cylinder, ground spark plug leads, one at a time. If noise lessens noticeably or disappears, it is isolated to that particular cylinder.
4. Try to isolate the noise to location in engine. Front to back; top to bottom. This can help determine which components are at fault.
5. Sometimes noises can be caused by moving parts coming in contact with other components. Examples are: flywheel or coupler; exhaust flappers rattling against exhaust pipe; crankshaft striking (pan, pan baffle, or dipstick tube); rocker arm striking valve cover; and loose flywheel cover. In many cases if this is found to be the problem, a complete engine tear down is not necessary.
6. When noise is isolated to a certain area and component, removal and inspection will be required. Refer to proper sections of service manual for information required for service.
7. If noise cannot be distinguished between engine or drive unit, remove drive from boat. Run a water supply directly to engine. Run engine without the drive to determine if noise is still there.

VALVE COVER AREA

LOCATION	POSSIBLE CAUSES
1. Valve cover area, timed to one-half engine speed, noise could be confined to one cylinder or may be found in any multitude of cylinders.	1. A. Rocker arm, striking valve cover B. Rocker arm out of adjustment C. Worn rocker arm D. Bent push rod E. Collapsed lifter

CYLINDER AREA

LOCATION	POSSIBLE CAUSES
1. Cylinder area, may be confined to one cylinder or found in more than one cylinder, timed to engine speed	1. A. Sticking valve B. Carbon build-up C. Connecting rod installed wrong D. Bent connecting rod E. Piston F. Piston rings G. Piston pin H. Cylinder worn

CAMSHAFT AREA

LOCATION	POSSIBLE CAUSES
1. Camshaft area, front of engine, timed to one-half engine speed	1. A. Camshaft timing sprocket or gear B. Timing chain C. Fuel pump D. Valve lifter E. Cam bearings
2. Camshaft area, center of engine, timed to one-half engine speed	2. A. Fuel pump B. Valve lifter C. Cam bearings
3. Camshaft area, rear of engine, timed to one-half engine speed	3. A. Distributor gear B. Valve lifter C. Cam bearings
4. Camshaft area, throughout engine, timed to one-half engine speed	4. A. Loss of oil pressure B. Valve lifters C. Cam bearings

CRANKSHAFT AREA

LOCATION	POSSIBLE CAUSES
1. Crankshaft area, front of engine, timed to engine speed	1. A. Crankshaft timing sprocket or gear B. Timing chain C. Main bearing D. Rod bearing
2. Crankshaft area, center of engine, timed to engine speed	2. A. Crankshaft striking pan or pan baffle B. Main bearing C. Rod bearing
3. Crankshaft area, rear of engine, timed to engine speed	3. A. Loose flywheel cover B. Loose coupler C. Loose flywheel D. Drive plate E. Main bearing F. Rod bearing
4. Crankshaft area, throughout engine, timed to engine speed	4. A. Loss of oil pressure B. Main bearings C. Rod bearings

MISCELLANEOUS

NOISE	POSSIBLE CAUSE
1. Engine spark knock	1. A. Advanced timing B. Low octane fuel C. Engine running hot D. Carbon deposits in engine
2. Popping through carburetor	2. A. Wrong ignition timing B. Carburetor set too lean C. Faulty accelerator pump D. Vacuum leak E. Valve adjustment F. Valve timing G. Burned or stuck valve
3. Hissing	3. A. Vacuum leak B. Fuel pump (hissing in sight tube) C. Leaking exhaust (manifolds or pipes) D. Loose cylinder heads E. Blown head gasket
4. Whistle	4. A. Vacuum leak B. Dry or tight bearing in an accessory
5. Sparks jumping	5. A. Leaking high tension lead B. Cracked coil tower C. Cracked distributor cap
6. Squeaks or squeals	6. A. Drive belt slipping B. Dry or tight bearing in an accessory C. Parts rubbing together
7. Rattling in exhaust pipe area	7. A. Exhaust shutters

Oil Pressure

NOTICE
Refer to "Section 1, Part B" for minimum oil pressure reading.

IMPORTANT INFORMATION

1. Measuring oil pressure	1. Use a good automotive oil pressure test gauge. Do not rely on the oil pressure gauge in the boat.
2. Check engine oil level with boat at rest in the water	2. Oil level should be between the "ADD" and "FULL" marks
3. Oil level in crankcase above "FULL" mark	3. May cause loss of engine RPM, oil pressure gauge fluctuation, drop in oil pressure, and hydraulic valve lifter noise at high RPM.
4. Oil level in crankcase below "ADD" mark	4. Low oil pressure; oil pressure gauge fluctuation; internal engine noise and/or damage
5. Change in oil pressure	5. This may be a normal condition. Oil pressure may read high in the cooler times of the day, and when engine is not up to operating temperature. As the air temperature warms up and engine is running at normal operating temperature, it is normal for oil pressure to drop off slightly.
6. Low engine oil pressure at idle	6. With modern engines and engine oils, low oil pressure readings at idle does not necessarily mean there is a problem. If valve lifters do not "clatter" (at idle), there is a sufficient volume of oil to lubricate all internal moving parts properly. The reason for the drop in oil pressure is that engine heat causes an expansion of the internal tolerances in the engine and, also, the oil will thin out somewhat from heat.
7. Low engine oil pressure at idle after running at a high RPM	7. Refer to "No. 5 and 6," preceding
8. Boats with dual engines	8. It is not uncommon to see different oil pressure readings between the two engines, as long as both engines fall within specifications. Differences in oil pressure can be attributed to differences in engine tolerances, gauges, wiring, senders, etc.
9. Boats with dual stations	9. Refer to "No. 8," preceding

LOW OIL PRESSURE

NOTICE
Refer to "Section 1, Part B" for minimum oil pressure readings.

CAUSE	SPECIAL INFORMATION
1. Low oil level in crankcase	
2. Defective oil pressure gauge and/or sender	2. Verify with an automotive test gauge. Refer to "Section 4, Part D" for instrument testing.
3. Thin or diluted oil	3. Oil broken down; contains water or gas; wrong viscosity; engine running too hot or too cold; excessive idling in cold water (condensation)
4. Oil pump	4. Relief valve stuck open; pick-up tube restricted; worn parts in oil pump; air leak on suction side of oil pump or pick-up tube
5. Oil leak can be internal or external	5. Oil passage plugs leaking, cracked or porous cylinder block
6. Excessive bearing clearance	6. Cam bearings, main bearings, rod bearings

HIGH OIL PRESSURE

CAUSE	SPECIAL INFORMATION
1. Oil too thick	1. Wrong viscosity, oil full of sludge or tar
2. Defective oil pressure gauge and/or sender	2. Verify with an automotive test gauge **IMPORTANT: Oil pressure, slightly higher than normal, does not always indicate a problem. Tolerance stack-up in the engine, oil viscosity, and weather conditions could cause high oil pressure.**
3. Clogged or restricted oil passage	
4. Oil pump relief valve stuck closed	

Excessive Oil Consumption

CAUSE	SPECIAL INFORMATION
1. Normal consumption (NOTE)	1. One quart of oil consumed in 5-15 hours of operation at WOT (especially in a new or rebuilt engine) is normal
2. Oil leaks	2. Clean bilge, run engine with clean white paper on bilge floor, locate oil leak(s)
3. Oil too thin	3. Oil diluted or wrong viscosity
4. Oil level too high	
5. Drain holes in cylinder head plugged	5. Oil will flood valve guides
6. Defective valve seals	
7. Intake manifold gasket leaking	
8. Worn valve stems or valve guides	
9. Defective oil cooler (if so equipped)	9. Crack in cooler tubes
10. Defective piston rings	10. Glazed, scuffed, worn, stuck, improperly installed; ring grooves worn; improper break-in; wrong end gap
11. Defective cylinders	11. Out of round, scored, tapered glazed; excessive piston to cylinder clearance; cracked piston
12. Excessive bearing clearance	

NOTE: ENGINE CRANKCASE OIL MUST BE CHECKED AT INTERVALS SPECIFIED IN "MAINTENANCE CHART." It is normal for an engine to use a certain amount of oil in the process of lubricating and cooling the engine. Oil consumption will be higher on the 8.2 litre and 454/502 Magnums. These engines utilize forged (rather than cast) aluminum pistons to withstand the higher stresses created by their higher horsepower output. The forged pistons require increased piston-to-cylinder bore clearance to accommodate their higher thermo-expansion rate and thus, it is normal for some oil to be burnt-up in the combustion chambers. The amount of oil consumption is greatly dependant upon engine speed, with consumption being highest at wide-open-throttle and decreasing substantially as engine speed is reduced. It is not uncommon for big block high performance engines to use up to 1 quart of oil in 1-5 hours if the engine is operated continuously at the upper end of the RPM range.

Water in Engine

IMPORTANT INFORMATION

IMPORTANT: First determine location of water in engine. This information can be of great help when trying to determine where the water came from and how it got into the engine. The three most common problems are "water on top of pistons, water in crankcase oil, water in crankcase oil and on top of pistons."

The first step, after locating water, is to remove all the water from the engine by removing all spark plugs and pump cylinders out by cranking engine over. Next change oil and filter. Now, start engine and see if problem can be duplicated. If problem can be duplicated, there more than likely is a mechanical problem. If the problem cannot be duplicated, the problem is either an operator error or a problem that exists only under certain environmental conditions.

If water is contained to cylinder(s) only, it is usually entering through the intake system, exhaust system, or head gasket.

If the water is contained to crankcase only, it is usually caused by a cracked or porous block, a flooded bilge, or condensation.

If the water is located in both the cylinder(s) and the crankcase, it is usually caused by water in the cylinders getting past the rings and valves, or complete submersion.

Checking for rust in the intake manifold or exhaust manifolds is a good idea. Rust in these areas will give clues if the water entered through these areas.

WATER ON TOP OF PISTONS

CAUSE	SPECIAL INFORMATION
1. Operator shut engine off at high RPM	
2. Engine "diesels" or trys to run backwards	2. Engine out of tune, poor fuel, high idle RPM, timing set too high
3. Rain water running into flame arrestor	3. Hatch cover
4. Spark plug misfiring	4. Improper combustion causes moisture in the air to accumulate in the cylinder
5. Backwash through the exhaust system	
6. Improper engine or exhaust hose installation	6. Refer to "Section 7, Part A" for exhaust specifications
7. Cracked exhaust manifold	
8. Improper manifold to elbow gasket installation	
9. Loose cylinder head bolts	
10. Blown cylinder head gasket	10. Check for warped cylinder head or cylinder block
11. Cracked valve seat	
12. Porous or cracked casting	12. Check cylinder heads, cylinder block, and intake manifold

WATER IN CRANKCASE OIL

CAUSE	SPECIAL INFORMATION
1. Water in boat bilge	1. Boat has been submerged or bilge water was high enough to run in through dipstick tube.
2. Water seeping past piston rings or valves	2. Refer to "Water in Engine" ("On Top of Pistons")
3. Engine running cold	3. Defective thermostat, missing thermostat; prolonged idling in cold water
4. Intake manifold leaking near a water passage	
5. Cracked or porous casting	5. Check cylinder head, cylinder block, and intake manifold

Water in Engine

IMPORTANT INFORMATION

IMPORTANT: First determine location of water in engine. This information can be of great help when trying to determine where the water came from and how it got into the engine. The three most common problems are "water on top of pistons, water in crankcase oil, water in crankcase oil and on top of pistons."

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If the water is located in both the cylinder(s) and the crankcase, it is usually caused by water in the cylinders getting past the rings and valves, or complete submersion.

Checking for rust in the intake manifold or exhaust manifolds is a good idea. Rust in these areas will give clues if the water entered through these areas.

WATER ON TOP OF PISTONS

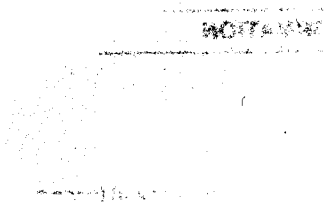
CAUSE	SPECIAL INFORMATION
1. Operator shut engine off at high RPM	
2. Engine "diesels" or trys to run backwards	2. Engine out of tune, poor fuel, high idle RPM, timing set too high
3. Rain water running into flame arrestor	3. Hatch cover
4. Spark plug misfiring	4. Improper combustion causes moisture in the air to accumulate in the cylinder
5. Backwash through the exhaust system	
6. Improper engine or exhaust hose installation	6. Refer to "Section 7, Part A" for exhaust specifications
7. Cracked exhaust manifold	
8. Improper manifold to elbow gasket installation	
9. Loose cylinder head bolts	
10. Blown cylinder head gasket	10. Check for warped cylinder head or cylinder block
11. Cracked valve seat	
12. Porous or cracked casting	12. Check cylinder heads, cylinder block, and intake manifold

WATER IN CRANKCASE OIL

CAUSE	SPECIAL INFORMATION
1. Water in boat bilge	1. Boat has been submerged or bilge water was high enough to run in through dipstick tube.
2. Water seeping past piston rings or valves	2. Refer to "Water in Engine" ("On Top of Pistons")
3. Engine running cold	3. Defective thermostat, missing thermostat; prolonged idling in cold water
4. Intake manifold leaking near a water passage	
5. Cracked or porous casting	5. Check cylinder head, cylinder block, and intake manifold

Engine Overheats (Cooling System)

CAUSE	SPECIAL INFORMATION
IMPORTANT: The first step is to verify if the engine is actually overheating or the temperature gauge or sender is faulty.	**IMPORTANT: Best way to test gauge or sender is to replace them.**
1. Loose or broken drive belt	
2. Seawater shut-off valve partially or fully closed (if equipped)	
3. Clogged or improperly installed sea strainer	
4. Loose hose connections between seawater pick-up and seawater pump inlet. (Models with belt driven seawater pump only)	4. Pump will suck air. Pump may fail to prime or will force air bubbles into cooling system.
5. Seawater inlet hose kinked or collapsed	
6. Seawater pick-up clogged	
7. Obstruction on boat bottom causing water turbulence	7. Obstruction will be in front of seawater pick-up, causing air bubbles to be forced into cooling system.
8. Defective thermostat	
9. Exhaust elbow water outlet holes plugged	
10. Insufficient seawater pump operation	10. Worn pump impeller
11. Obstruction in cooling system such as casting flash, sand, rust, salt, etc.	11. Refer to water flow diagram for engine type being serviced
12. Engine circulating pump defective	
13. Also refer to "Engine Overheats (Mechanical)"	13. See "Table of Contents"
IMPORTANT: In addition to previous checks, make the following checks if engine is equipped with closed cooling.	
14. Low coolant level	
15. Anti-freeze not mixed properly	15. Anti-freeze should be mixed 50/50 or maximum 60/40. 60% anti-freeze, 40% water.
16. Heat exchanger cores plugged	
17. Water hoses reversed at the water distribution block	17. Refer to water flow diagrams "Section 6"
18. For further testing of the closed cooling system	18. Refer to "Section 6, Part B"



INSUFFICIENT WATER FLOW FROM Alpha One STERN DRIVE UNIT SEAWATER PICKUP PUMP

CAUSE	SPECIAL INFORMATION
1. Seawater shut-off valve partially or fully closed (if equipped)	
2. Water pickups clogged with foreign material	
3. Kinked or broken bell housing-to-gimbal housing water tube hose	
4. Corroded thru gimbal housing water tube	
5. Water pickup inserts warped. (Engine will overheat while boat is underway only.)	5. Pickup inserts must not protrude above gear housing surface or inserts will create an irregular or turbulent water flow over the water pickup holes. Consequently, this may cause loss of cooling water and subsequent engine overheating. This condition also can be identified by cavitation burn (pitting, erosion) on the gear housing in the area aft of the water pickup inserts.
6. Damaged gear housing or accessories improperly installed on boat bottom or transom (speedometer pickup, depth sounder transducer, etc.). Substantial amount of barnacles or other marine growth on gear housing or boat bottom. (Engine will overheat while underway only.)	6. An object or an irregularity on boat or gear housing in area close to water pickups could create turbulence in water flow going to water pickups. This could aerate the water flow and cause engine to overheat.
7. Stern drive installed too high on transom or drive unit trimmed too far out allowing air to be drawn into pump. (Engine will overheat while underway only.)	7. Contact boat company if stern drive is installed too high. Instruct operator on proper trimming technique if unit is trimmed out too far.
8. Bell housing-to-drive shaft housing O-ring missing or damaged	
9. Faulty seawater pickup pump	
10. Seawater pickup pump water tube corroded thru	
11. Drive shaft housing water pocket cover cracked	
12. Broken-off impeller blade or other obstruction in water passages (usually lodges in drive shaft housing water pocket cover or cross-drilled water passage).	12. To check cross-drilled water passage in drive shaft housing, remove welch plug and pipe plug located under decal on starboard side of housing. Drive unit must be shifted into reverse to remove pipe plug.
13. Water passage in drive shaft housing improperly drilled	

INSUFFICIENT WATER FLOW FROM BELT DRIVEN SEAWATER PICKUP PUMP

CAUSE	SPECIAL INFORMATION
1. Drive belt	1. Loose, worn or broken
2. Seawater shut-off valve partially or fully closed	
3. Clogged or improperly installed sea strainer	
4. Loose hose connections between seawater pickup and seawater pump inlet	4. Pump will suck air, pump may fail to prime or will force air bubbles into cooling system.
5. Seawater inlet hose kinked or plugged	
6. Seawater pickup clogged	
7. Obstruction on boat bottom causing water turbulence	7. Obstruction will be in front of seawater pickup, causing air bubbles to be forced into cooling system
8. Faulty seawater pump	

Power Steering

POOR, ERRATIC, OR NO ASSIST

CAUSE	SPECIAL INFORMATION
1. Drive belt	1. Worn, broken or out of adjustment
2. Low fluid level	
3. Air in system	3. Air leak in lines, pump, or air from installation. Refer to Section 1B for bleeding procedure.
4. Leaking hoses	4. Refer to Section 1B for bleeding procedure
5. Steering cable and/or steering helm	5. Cable or helm partially froze from corrosion or rust; cable over lubricated; improper cable installation
6. Binding in stern drive unit	6. Refer to appropriate "Stern Drive Service Manual"
7. Restriction in hydraulic hoses	7. Causes a loss of pressure
8. Control valve not positioned properly, not balanced properly, or the mounting nut is loose	
9. Mounting bracket adjusting screw loose or mounting tube is loose	
10. Faulty pump	10. Flow control valve may be sticking
11. Worn piston ring or scored housing bore in cylinder	11. Causes loss of pressure
12. Leaking valve body or loose fitting spool	

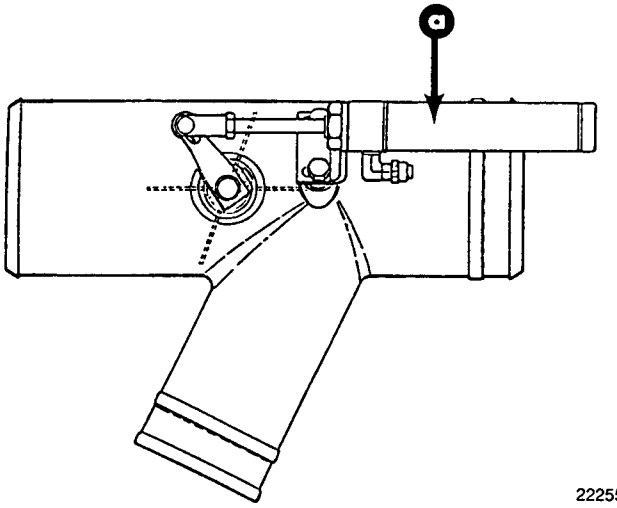
NOISY PUMP

CAUSE	SPECIAL INFORMATION
1. Drive belt	1. Check tension
2. Low fluid level	
3. Air in fluid	3. Air leak in lines, pump, or air from installation. Refer to Section 1B for bleeding procedure.
4. Faulty pump	4. Use stethoscope to listen for noise in the pump
5. Restricted fluid passages	5. Kinks or debris in hoses or debris in passages
6. Stop nut adjusted improperly	6. Refer to appropriate "Stern Drive Service Manual"
7. Steering cables installed that do not meet BIA standards	7. Refer to appropriate "Stern Drive Service Manual"

FLUID LEAKS

CAUSE	SPECIAL INFORMATION
1. Loose hose connections	1. Refer to Section 1B for bleeding procedure
2. Damaged hose	
3. Oil leaking from top of pump	3. System overfilled; fluid contains water; fluid contain air
4. Cylinder piston rod seal	
5. Faulty seals in valve	
6. Faulty seals or O-rings in pump	
7. Cracked or porous metal parts	

Troubleshooting Silent Choice Exhaust Silencer System



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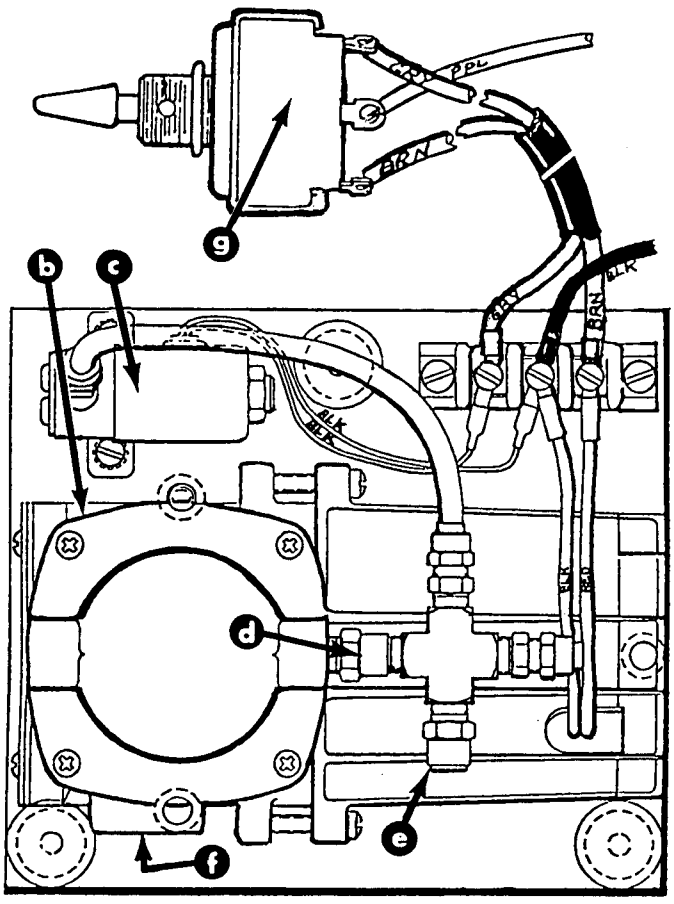

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a - Air Cylinder Assembly
b - Air Pump
c - Solenoid
d - Check Valve
e - Relief Valve
f - Air Intake Filter
g - Mode Switch

NOTE: Perform the following tests with engine(s) not running.

Compressor will not run

1. Testing mode switch (ignition switch in "run" position).
   a. Purple wire must have battery voltage. If not, fuse is blown or wiring is faulty.
   b. Brown wire must have battery voltage when mode switch is held in "thru transom" position. If not, switch is faulty.
   c. Gray wire must have battery voltage whe mode switch is held in "thru prop" position. If not, switch is faulty.
2. Testing air pump (ignition switch in "run" position).
   a. Check that black wire, in terminal block, is grounded to engine.
   b. Brown wire, in terminal block, must have battery voltage when mode switch is held in "thru transom" position. If not, wiring is faulty. If voltage is present, air pump is faulty.

Air pump runs — system inoperative

With air pump running, check hoses, fittings, solenoid, and relief valve for air leakage. Replace parts as needed.

System operates but goes "thru prop" after air pump stops running

1. Check that air pressure is not leaking past solenoid. If so, replace.
2. Check that air pressure is not leaking back thru air pump. If so, replace check valve.
3. Check that air pressure is not leaking at air cylinder assemblies. If so, replace faulty ones.

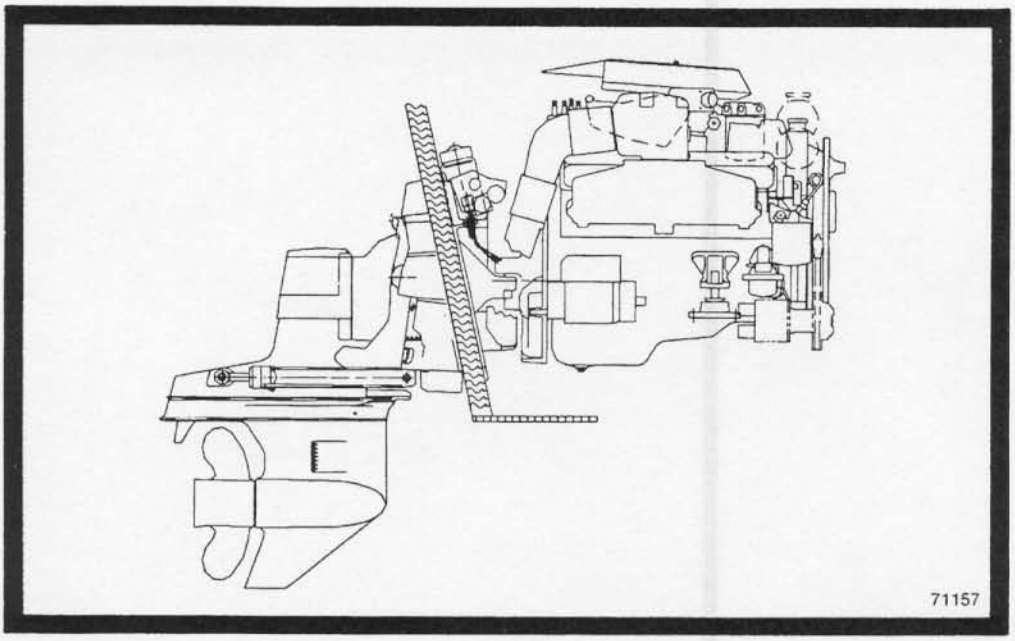
System stays in "thru transom" mode, will not go back to "thru prop" mode

Gray wire, in terminal block, must have battery voltage when mode switch is held in "thru prop" position. If not, wiring is faulty. If voltage is present, solenoid is faulty.

REMOVAL and INSTALLATION

2

A



MCM MODELS with ALPHA ONE DRIVES

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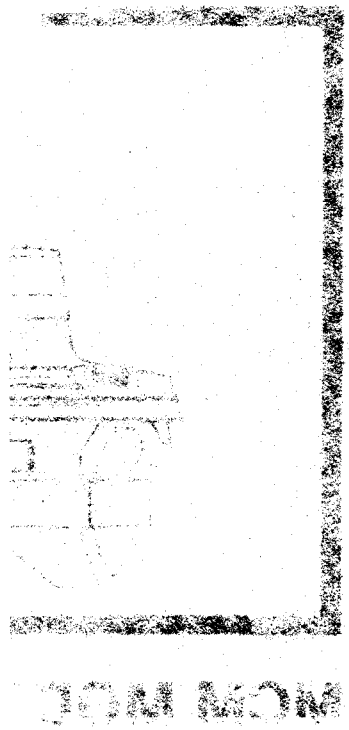


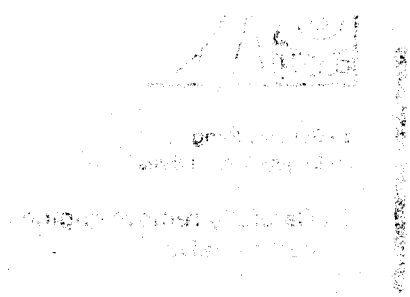
Torque Specifications

Fastener Location	Lb. Ft. (N·m)	Lb. In. (N·m)
Battery Cables	Securely	
Drive Unit Shift Cable		
Brass Barrel	Spread Cotter Pin	
Cable End Guide	(Note 1)	
Front Engine Mount	Securely	
Hose Clamps	Securely	
Power Steering Fluid Hose Fittings		
Large	20-25 (27-34)	
Small		96-108 (11-12)
Rear Engine Mounts	35-40 (47-54)	
Remote Control Shift Cable		
Brass Barrel	Securely	
Cable End Guide	(Note 1)	
Remote Control Throttle Cable		
Brass Barrel	Securely	
Cable End Guide	(Note 1)	

NOTE: Tighten, then back nut off 1 full turn.

Tools/Lubricants/Adhesives/Sealants

Part Number	Description
91-57797A3	Engine Alignment Tool
91-816391A4	Engine Coupler Spline Grease
92-25711--1	Liquid Neoprene
Obtain Locally	Loctite Pipe Sealant with Teflon



Removal

IMPORTANT: Stern drive unit must be removed prior to engine removal. Refer to "Stern Drive Service Manual."

1. Disconnect battery cables from battery.
2. Remove instrument harness connector plug from engine harness receptacle after loosening clamp.

⚠WARNING

Be careful when working on fuel system. Gasoline is extremely flammable and highly explosive under certain conditions. Do not smoke or allow spark or open flame in area. Wipe up any spilled fuel immediately.

3. Disconnect and suitably plug fuel line, to prevent fuel in tank from leaking into bilge.
4. Disconnect throttle cable from carburetor and retain locknuts and hardware.
5. Disconnect bullet connectors of trim sender wires (coming from transom assembly) from engine harness or from terminal block (if so equipped) on circuit breaker/solenoid mounting bracket.
6. Disconnect MerCathode wires from MerCathode controller on engine (some models).
7. Disconnect water inlet hose from gimbal housing.
8. Disconnect exhaust elbow hoses.
9. Remove both shift cables from shift plate. Retain locknuts and hardware.
10. Disconnect any grounding wire or accessories that are connected to engine.
11. **Power Steering Models:** Disconnect (and suitably plug) fluid hoses from power steering control valve on transom.

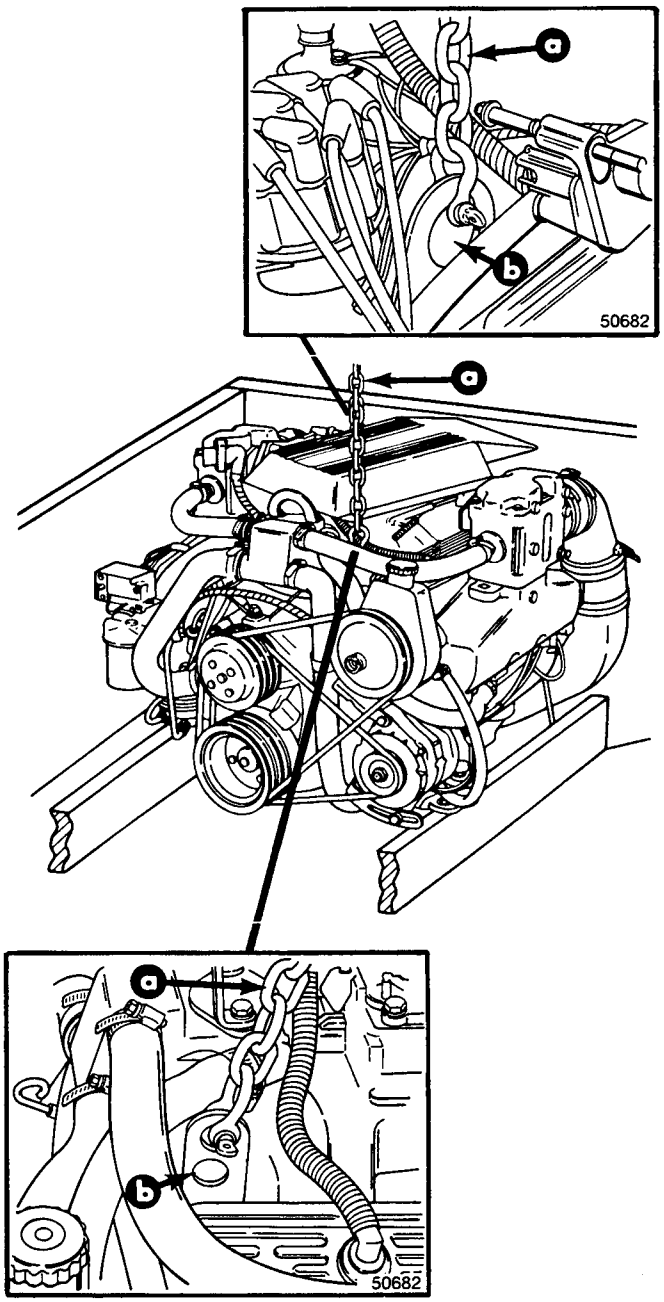
⚠CAUTION

Center lifting eye (located on top of thermostat housing) is used for engine alignment only. Do not use to lift entire engine.

⚠CAUTION

Do not allow lifting sling to hook or compress engine components or damage will occur.

12. Support engine with suitable sling through lifting eyes on engine and remove front and rear engine mounting bolts. Retain hardware.



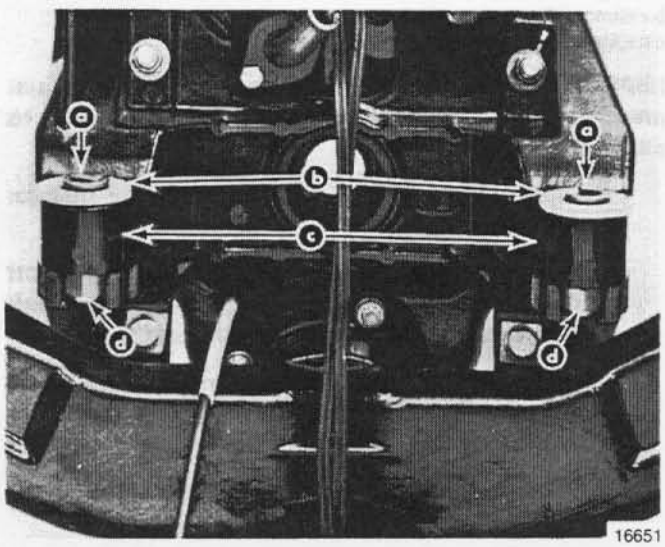
a - Suitable Sling
b - Engine Lifting Eyes

13. Carefully remove engine. Do not hit power steering control valve.

Installation

Engine Installation/Alignment

1. Follow instructions "a" - "e":
   a. Be certain fiber washers (cemented in place) on inner transom plate are present. Inspect fiber washers. Replace if worn or damaged.
   b. Install double wound lockwashers onto inner transom plate inside fiber washer.
   c. Be certain rear engine mount locknuts are in position as shown.
   d. Lubricate exhaust bellows with soap/water to ease installation.
   e. Lubricate engine coupling splines with 2-4-C Marine Lubricant.



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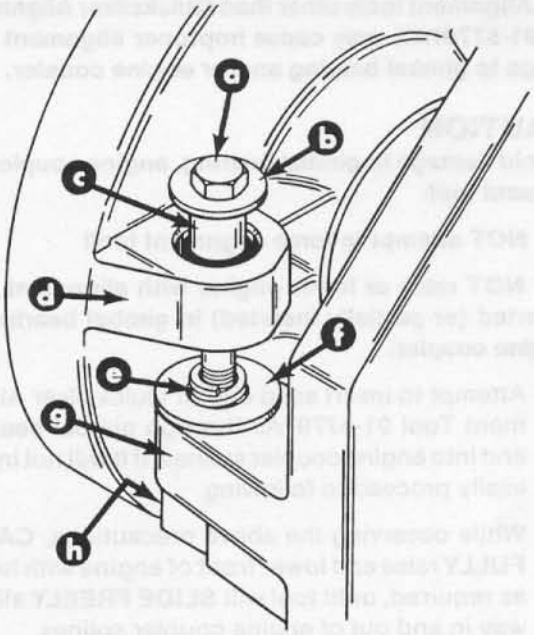
a - Double Wound Lockwasher
b - Fiber Washer (Cemented in Place)
c - Inner Transom Plate Mount (Engine Support)
d - Locknuts (Engine Mounting Bolts)

2. Attach a suitable sling to lifting eyes on engine and adjust so that engine is level when suspended. (Refer to "Removal" section for location of lifting eyes.)
3. Lift engine into position (in boat), using an overhead hoist.
4. Align rear engine mounts with inner transom plate mounts while simultaneously aligning exhaust tubes with exhaust pipe bellows.

IMPORTANT: Engine attaching hardware must be installed in sequence shown.

5. Install both rear engine mounting bolts and hardware as shown. Torque to 35-40 lb. ft. (47-54 N·m).



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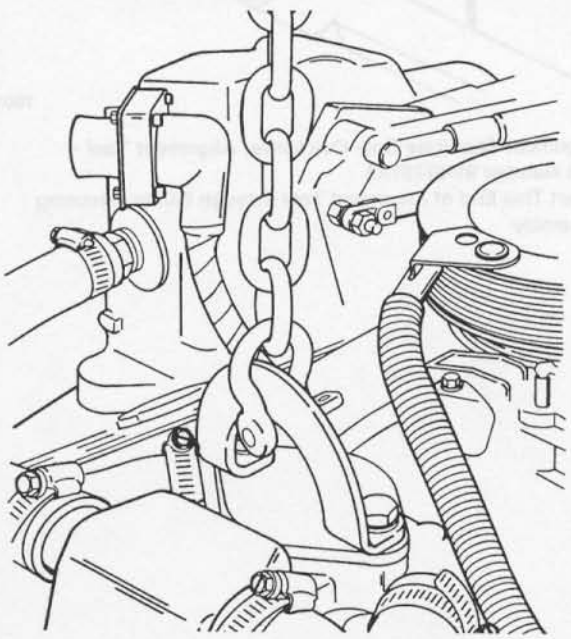
a - Bolt, Rear Engine Mounting
b - Washer, Large Steel
c - Spacer, Metal
d - Rear Engine Mount
e - Fiber Washer With Double Wound Lockwasher in the Center
f - Inner Transom Plate Mounts
g - Locknut (Hidden In This View)

⚠CAUTION

When lowering engine into position DO NOT set engine on shift cable. Shift cable outer casing can be crushed causing difficult or improper shifting.

6. Set engine down on stringers and relieve hoist tension. Disconnect sling from engine lifting eyes and switch sling to center lifting eye.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7. Align engine as follows:

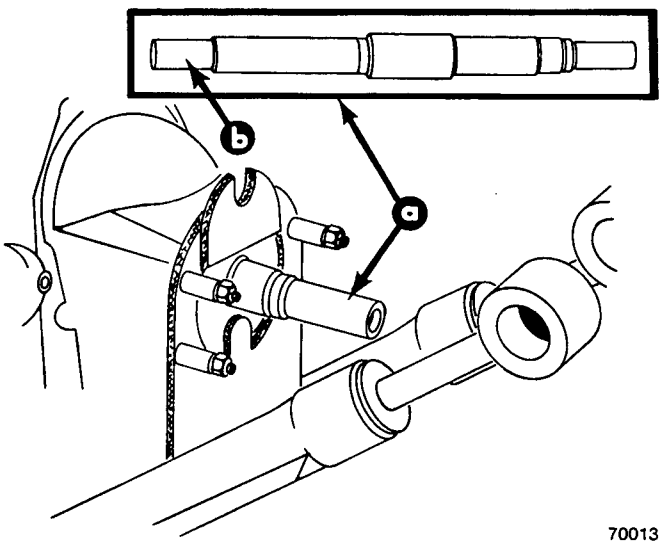
⚠CAUTION
DO NOT use an alignment tool from another manufacturer. Alignment tools other than Quicksilver Alignment Tool 91-57797A3, may cause improper alignment and damage to gimbal bearing and/or engine coupler.

⚠CAUTION
To avoid damage to gimbal bearing, engine coupler, or alignment tool:

- **DO NOT attempt to force alignment tool!**
- **DO NOT raise or lower engine with alignment tool inserted (or partially inserted) in gimbal bearing or engine coupler.**

a. Attempt to insert solid end of Quicksilver Alignment Tool 91-57797A3 through gimbal bearing and into engine coupler splines. If it will not insert easily proceed to following.

b. While observing the above precautions, **CAREFULLY** raise and lower front of engine with hoist, as required, until tool will **SLIDE FREELY** all the way in and out of engine coupler splines.



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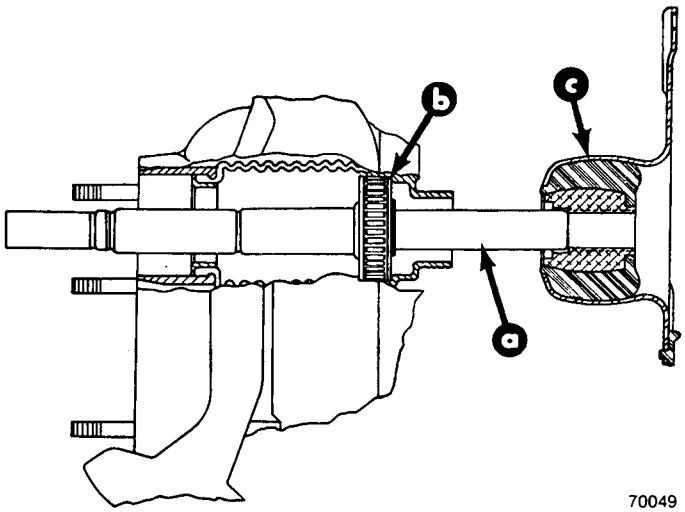
a - Alignment Tool (Use Only Quicksilver Alignment Tool - Part Number 91-57797A3
b - Insert This End of Alignment Tool through Gimbal Housing Assembly



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a - Alignment Tool
b - Gimbal Bearing
c - Engine Coupler

IMPORTANT: Turn both front engine mount adjustment nuts an equal amount in direction required to align engine.

c. Adjust front engine mounts until they rest on boat stringers.

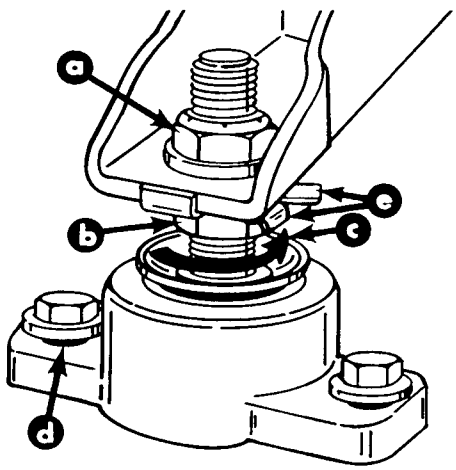
d. Relieve hoist tension entirely and fasten both front mounts to boat stringer using appropriate hardware (lag bolts or thru-bolts, etc.).

e. Recheck alignment with alignment tool. Tool must enter coupler splines freely. If not readjust front mounts.

f. When alignment is correct, tighten locknut or nut with lockwasher on each mount securely.

g. Bend tab washer down against flat on adjusting nut.

h. Remove alignment tool if not already removed.



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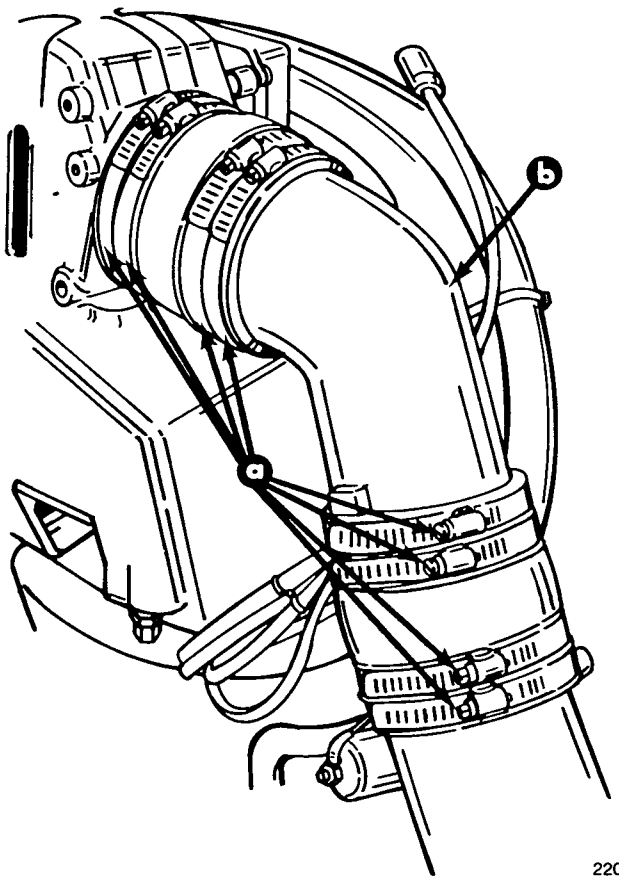
a - Nut with Lockwasher, or Locknut only
b - Adjustment Nut
c - Turn Adjustment Nut in this Direction (Counterclockwise) to Raise Front of Engine
d - Slotted Hole Toward Front of Engine
e - Tab Washer

8. Tighten all exhaust system hose clamps securely as follows (use two hose clamps on each connection):

   a. **On Engines With Thru-Prop Exhaust:**



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a - Hose Clamps - Tighten Securely
b - Exhaust Tube - Long Tube, Port Side
- Short Tube, Starboard Side

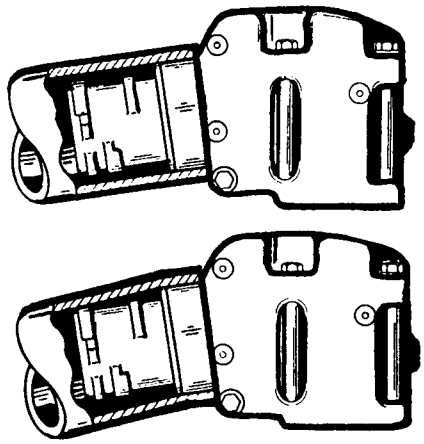
   b. **On Engines With Thru-Transom Exhaust:**

NOTICE (THRU-TRANSOM EXHAUST)

Exhaust hoses must be connected to exhaust elbows so that they do not restrict the flow of discharge water from exhaust elbow. If hoses are connected incorrectly, discharge water from exhaust elbow will not flow around entire inside diameter of hose. This will cause a hot spot in the hose which may eventually burn thru.

CORRECT

INCORRECT



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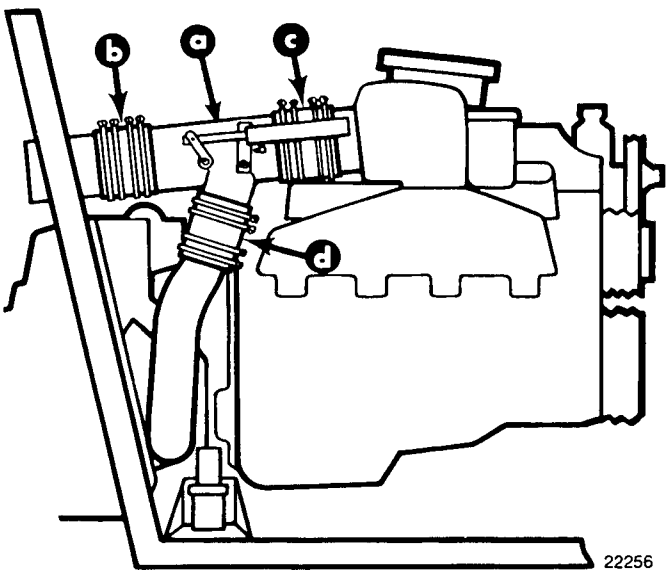
   c. **On Engines With Silent Choice Exhaust System:**



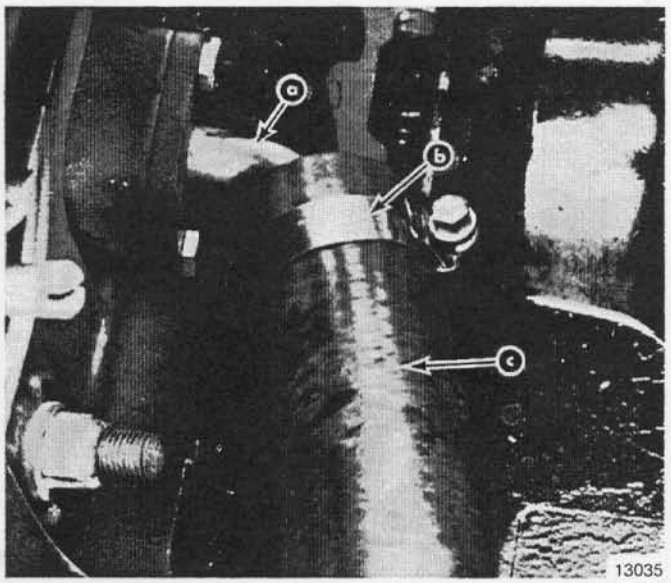
22256

a - Silencer Valve
b - Exhaust Hose and Clamps for Thru-Transom
c - Exhaust Hose and Clamps for Intermediate Exhaust Pipe
d - Exhaust Hose and Clamps for Exhaust Pipe

Engine Connections

IMPORTANT: When routing all wire harnesses and hoses, be sure they are routed and secured to avoid coming in contact with hot spots on engine and avoid contact with moving parts.

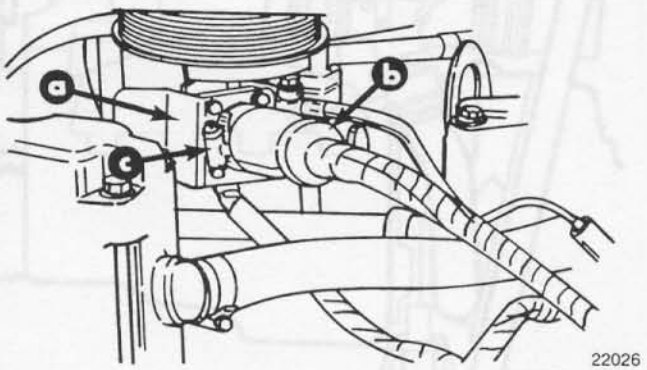
1. Connect water hose to water tube at gimbal housing with hose clamp. Tighten clamp securely.



13035

a - Water Inlet Tube
b - Hose Clamp
c - Water Inlet Hose

2. Connect instrument harness to engine harness with hose clamp. Tighten clamp securely.



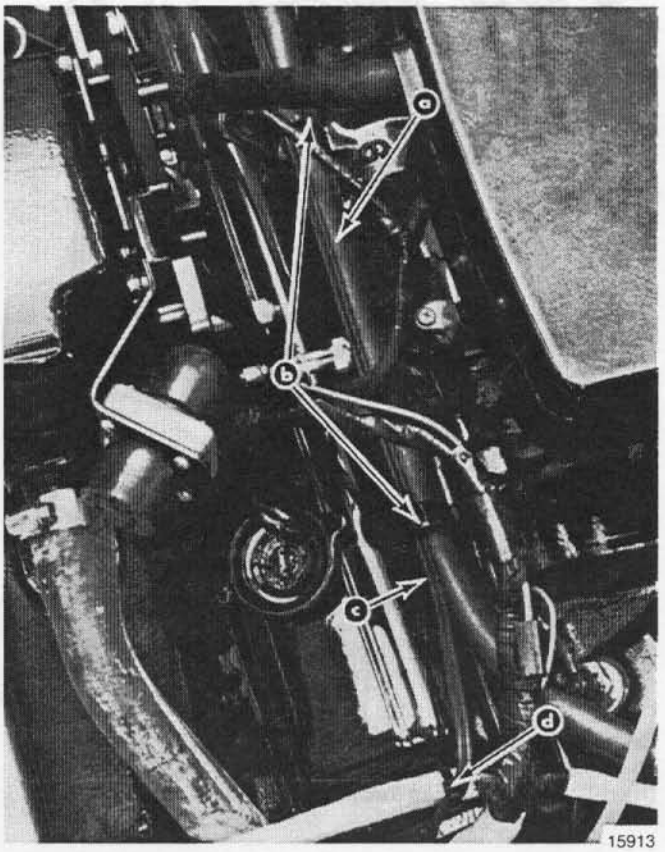
22026

a - Engine Wiring Harness Receptacle Bracket
b - Instrumentation Wiring Harness Plug
c - Hose Clamp - Tighten Securely

3. Connect trim position sender wires following instructions "a" or "b":

   a. **On earlier engines with engine harness/trim sender wires attached at insulated terminal block:**

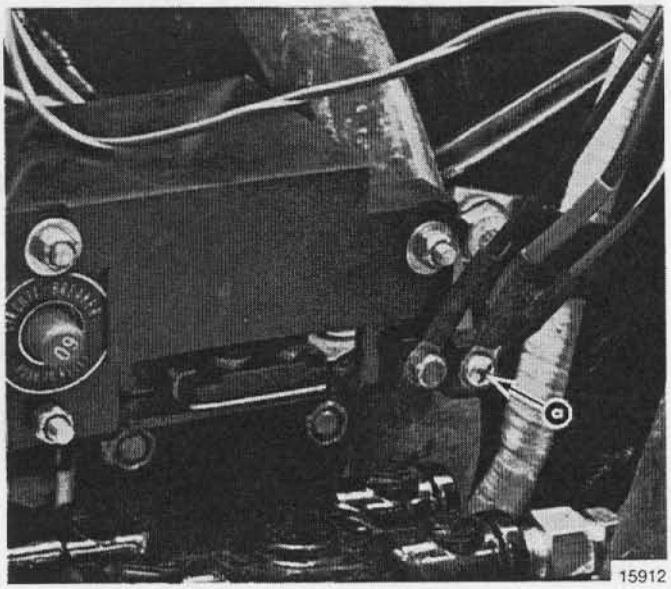
      (1) Route wires through hose clips on power steering hydraulic hose as shown. Use sta-straps as indicated.



15913

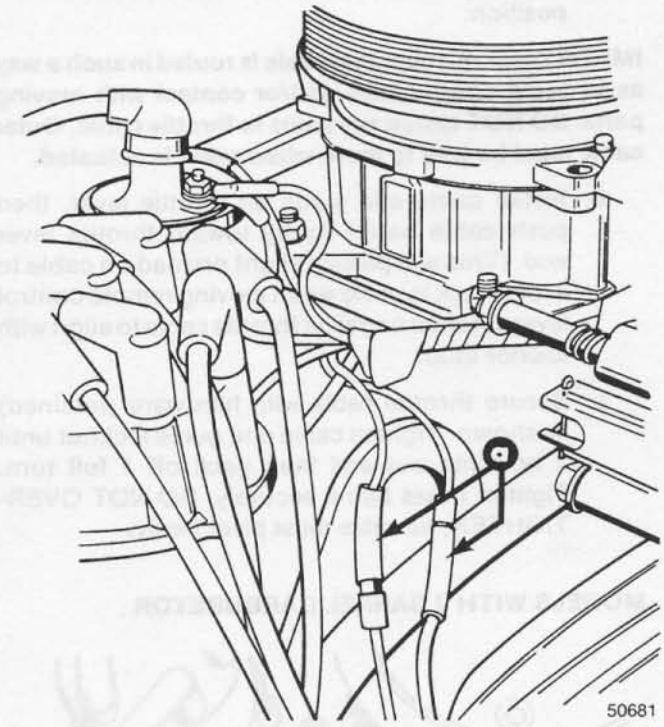
a - Power Steering Hydraulic Hose
b - Hose Clips
c - Trim Position Sender Wires (Route Thru Hose Clips)
d - Sta-Strap Leads at This Location

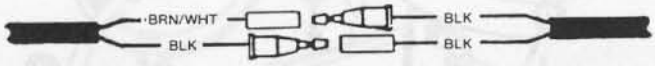
(2) Connect ring terminals to terminal block screws as shown, or connect bullet connectors to adaptors if so equipped (not shown).



a - Terminal Block
b - Brown or Purple Sleeve — To Insulated
c - Brown/White Wire — Terminal
d - Without Sleeve - To Terminal Block Mounting Screw

b. **On later engines with engine harness/trim sender wires with bullet connectors:** Connect sender wires to engine harness as shown.





From Engine Harness — From Transom Assembly

a - Engine Harness Bullet Connectors

⚠WARNING

Be careful when working on fuel system. Gasoline is extremely flammable and highly explosive under certain conditions. Do not smoke or allow spark or open flame in area. Wipe up any spilled fuel immediately.

4. Connect fuel line (from fuel tank) to engine. Make certain connection is secure. Check for leaks.

5. Connect throttle cable using hardware retained and adjust as follows:

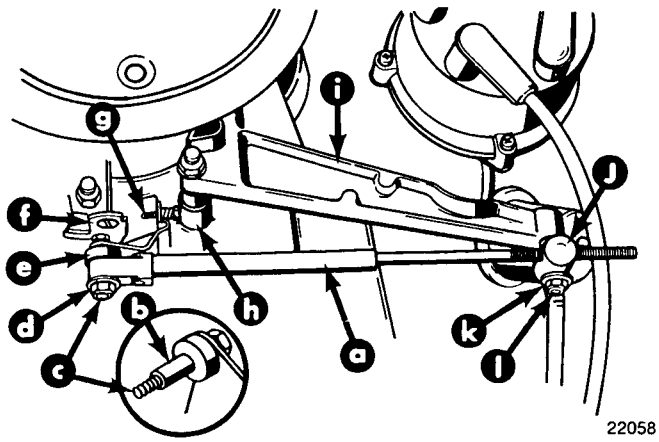
   a. Place remote control handle(s) in neutral, idle position.

IMPORTANT: Be sure that cable is routed in such a way as to avoid sharp bends and/or contact with moving parts. DO NOT fasten any items to throttle cable. Outer cable must be free to move when cable is actuated.

   b. Install cable end guide on throttle lever, then push cable barrel lightly toward throttle lever end. (This will place a slight preload on cable to avoid slack in cable when moving remote control lever.) Adjust barrel on throttle cable to align with anchor stud.

   c. Secure throttle cable with hardware (retained) as shown. Tighten cable end guide locknut until it bottoms out and then back off 1 full turn. Tighten brass barrel securely. DO NOT OVER-TIGHTEN, as cable must pivot freely.

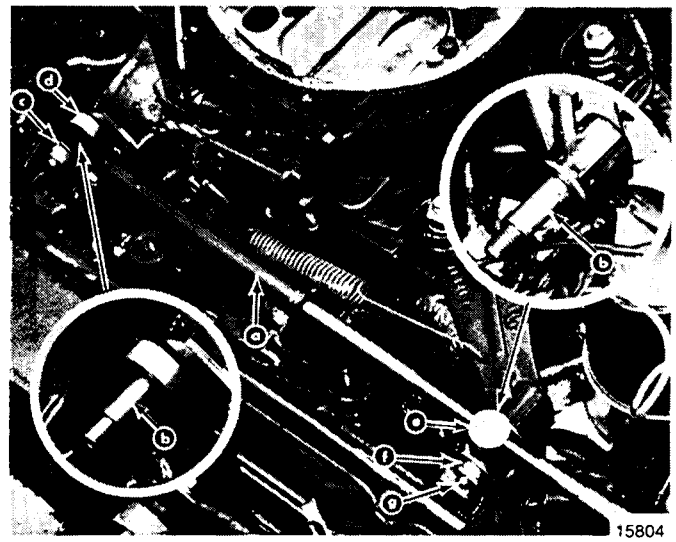
MODELS WITH 2 BARREL CARBURETOR



22058

a - Cable End Guide
b - Bushing On Throttle Lever Screw
c - Throttle Lever Stud
d - Locknut and Flat Washer. Tighten Until Nut Bottoms Out, Then Back Off 1 Full Turn
e - Spacer
f - Throttle Lever
g - Idle Speed Adjustment Screw
h - Idle Cam
i - Throttle Bracket
j - Cable Barrel
k - Flat Washer and Locknut
l - Throttle Cable Anchor Stud

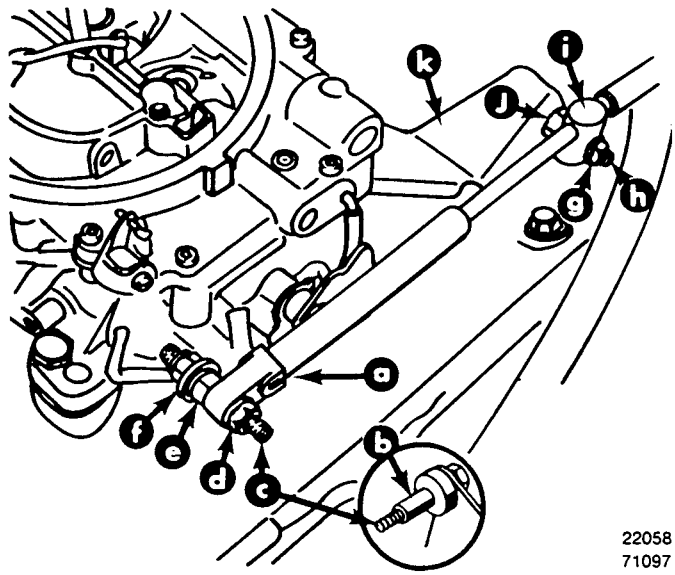
MODELS WITH 4 BARREL CARBURETOR



15804

a - Cable End Guide
b - Bushing
c - Washer, Nut and Screw (DO NOT Over-Tighten)
d - Spacer
e - Brass Barrel
f - Washer and Nut (DO NOT Over-Tighten)
g - Anchor Stud

Rochester Carburetor Shown



22058
71097

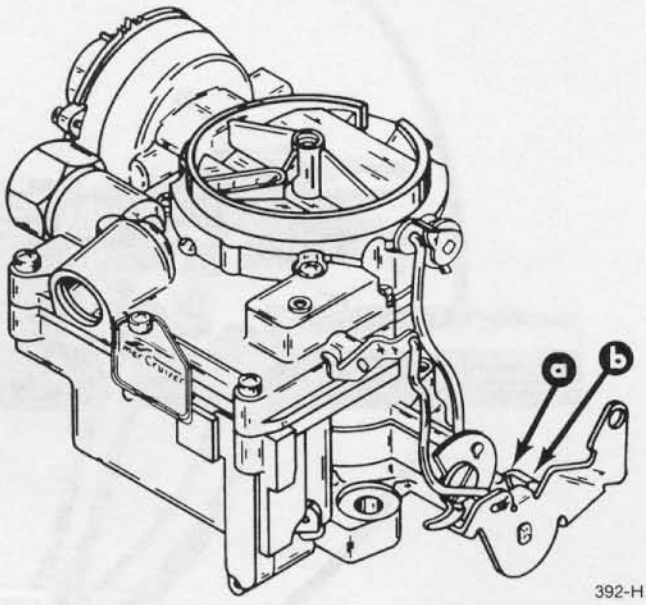
a - Cable End Guide
b - Bushing
c - Throttle Lever Stud
d - Locknut and Flat Washer - Tighten Until Nut Bottoms Out, Then Back Off 1 Full Turn
e - Spacer
f - Throttle Lever
g - Flat Washer and Locknut
h - Throttle Cable Anchor Stud
i - Cable Barrel
j - Flat Washer
k - Throttle Bracket

Weber Carburetor Shown

d. Place remote control throttle lever in the wide-open-throttle (W.O.T.) position. Check to ensure that throttle shutters (valves) are completely open and throttle shaft lever contacts carburetor body casting.

e. Return remote control throttle lever to idle position and check to ensure that throttle lever contacts idle speed adjustment screw.

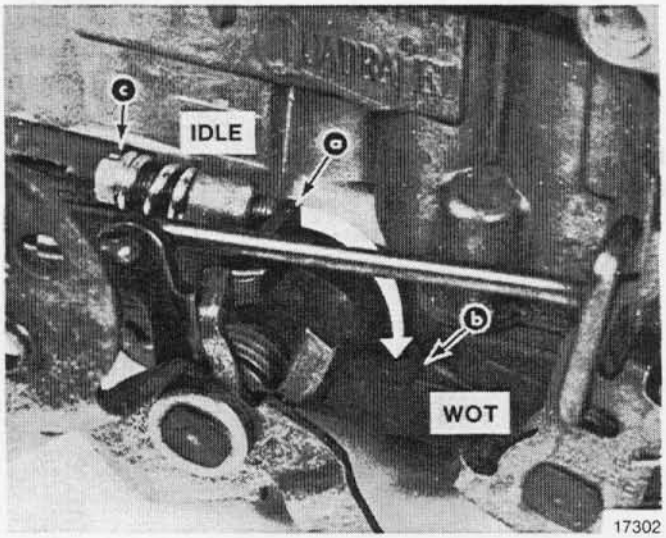
MODELS WITH 2 BARREL CARBURETOR



392-H

a - Throttle Lever Tang Against Stop
b - Idle Stop Screw

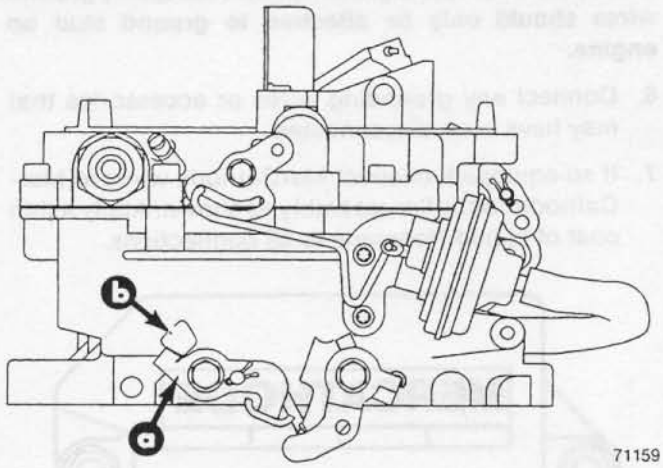
MODELS WITH ROCHESTER 4 BARREL CARBURETOR



17302

a - Tang
b - Carburetor Body
c - Idle RPM Adjustment Screw

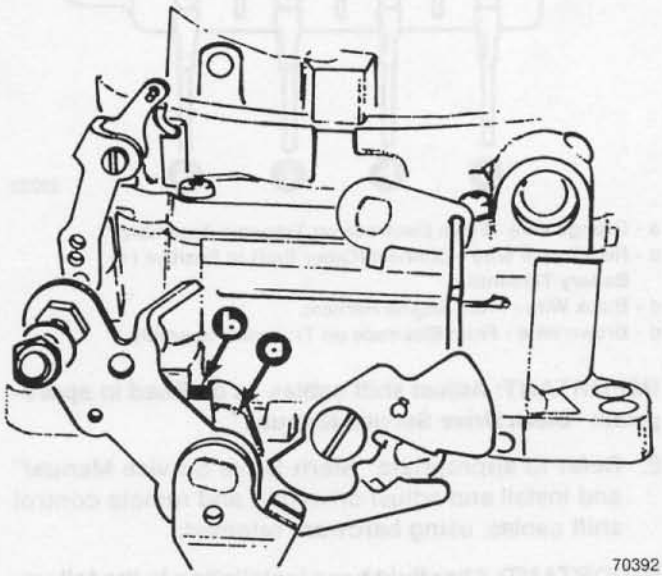
MODELS WITH WEBER 4 BARREL CARBURETOR



71159

a - Throttle Shaft Lever (Contacts "b" at W.O.T. Position)
b - Carburetor Body Casting

Wide-Open-Throttle Position Shown



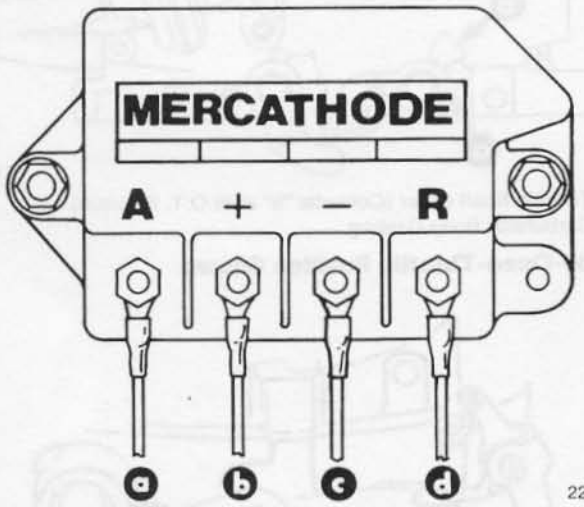
70392

a - Throttle Lever (Contacts "b" in Idle Position)
b - Idle Speed Adjustment Screw

Idle Position Shown

IMPORTANT: Do not attach any accessory ground (-) wires to transom plate ground point. Accessory ground wires should only be attached to ground stud on engine.

6. Connect any grounding wires or accessories that may have been disconnected.
7. If so equipped, connect MerCathode wires to MerCathode controller assembly as shown. Apply a thin coat of Liquid Neoprene to all connections.



22232

a - Orange Wire - From Electrode on Transom Assembly
b - Red/Purple Wire - Connect (Other End) to Positive (+) Battery Terminal
c - Black Wire - From Engine Harness
d - Brown Wire - From Electrode on Transom Assembly

IMPORTANT: Adjust shift cables as outlined in appropriate "Stern Drive Service Manual."

8. Refer to appropriate "Stern Drive Service Manual" and install and adjust drive unit and remote control shift cables, using hardware retained.

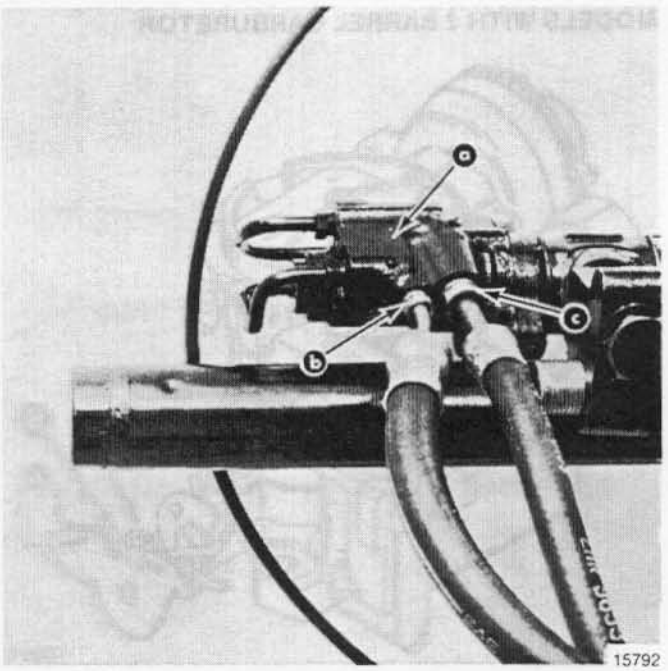
IMPORTANT: After fluid hose installation in the following, bleed power steering system as outlined in appropriate "Stern Drive Service Manual."

9. **Power Steering Models:** Connect power steering fluid hoses to control valve (large fitting first) as shown. Torque large fitting to 20-25 lb. ft. (27-34 N·m) and small fitting to 96-108 lb. in. (11-12 N·m).

⚠CAUTION
Route hoses exactly as shown below. This will help avoid stress on the hose fittings and will help avoid kinks in the hose.

IMPORTANT: Make hydraulic connections as quickly as possible to prevent fluid leakage.

IMPORTANT: Be careful not to cross-thread or overtighten fittings.



15792

a - Control Valve
b - Small Fitting
c - Large Fitting
Torque to Specifications

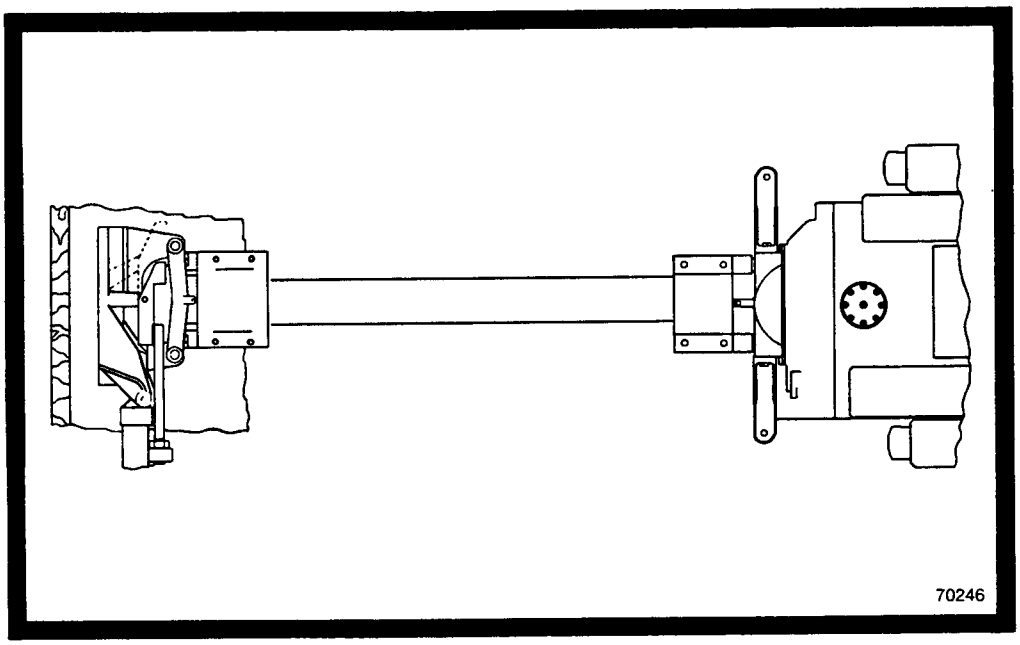
10. Connect battery cables to battery by FIRST connecting positive (+) battery cable (usually red) to positive (+) battery terminal. Tighten clamp securely. Then, connect negative (-) battery cable (usually black) to negative (-) battery terminal. Tighten clamp securely.

NOTE: Spray terminals with a battery connection sealant to help retard corrosion.

REMOVAL and INSTALLATION

2

B



MCM MODELS - ALPHA ONE DRIVES with DRIVESHAFT EXTENSION

Index

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Engine Mount Adjustment Was Not Disturbed During Service	2B-3
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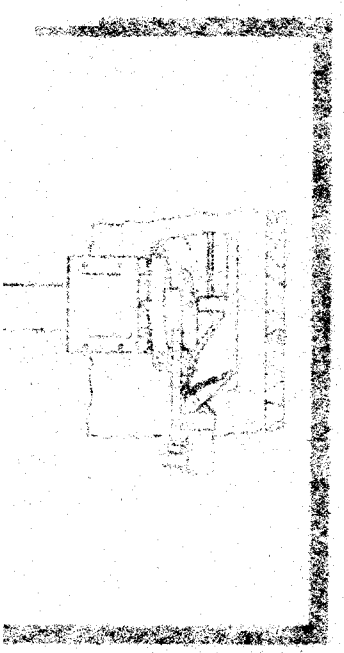
NOTICE

For service information on Drive Shaft and Bearing Support Assembly (Tailstock) refer to SECTION 8E - Drive Shaft Models/Propeller Shaft.



Torque Specifications

Fastener Location	Lb. Ft. (N·m)	Lb. In. (N·m)
Battery Cables	Securely	
Bearing Support to Inner Transom Plate	35-40 (47-54)	
Drive Shift	50 (68)	
Drive Shaft Shield	30 (41)	
Extension Housing to Flywheel Housing	30 (41)	
Flywheel Housing	30 (41)	
Front and Rear Engine Mounts	Securely	
Hose Clamps	Securely	
Rear Engine Mount Bracket	50 (68)	
Power Steering Fluid Hose Fittings		
Large	20-25 (27-34)	
Small		96-108 (11-12)
Remote Control Throttle Cable		
Brass Barrel	Securely	
Cable End Guide	(Note 1)	

NOTE: Tighten, then back nut off 1 full turn.

Tools/Lubricants/Adhesives/Sealants

Part Number	Description
91-57797A3	Engine Alignment Tool
91-816391A4	Engine Coupler Spline Grease
92-25711--1	Liquid Neoprene
Obtain Locally	Loctite 271

Removal

IMPORTANT: It is not necessary to remove the engine to service the drive shaft and/or bearing support (tailstock). Refer to instructions as outlined in Section 8E - "Drive Shaft Repair" or "Bearing Support Assembly (Tailstock) Repair" for servicing these items only.

IMPORTANT: Stern drive unit does not have to be removed prior to engine removal. If stern drive is going to be removed, refer to appropriate "Stern Drive Service Manual."

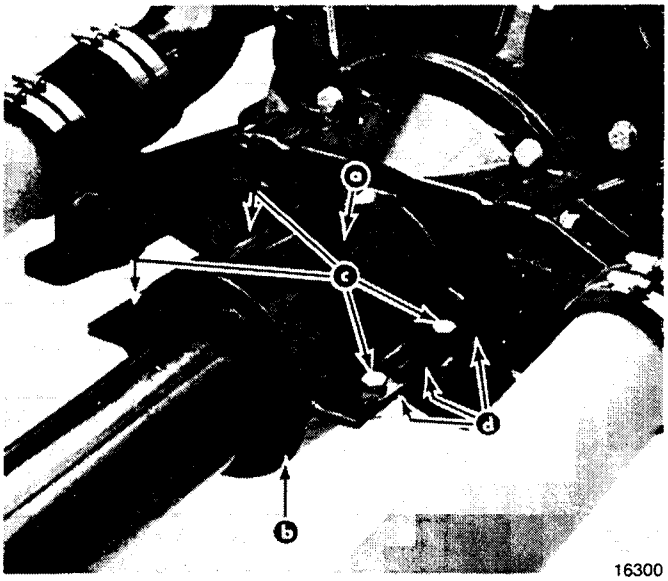
Engine

1. Disconnect battery cables from battery.
2. Remove instrument harness connector plug from engine harness receptacle after loosening clamp.

⚠WARNING

Be careful when working on fuel system. Gasoline is extremely flammable and highly explosive under certain conditions. Do not smoke or allow spark or open flame in area. Wipe up any spilled fuel immediately.

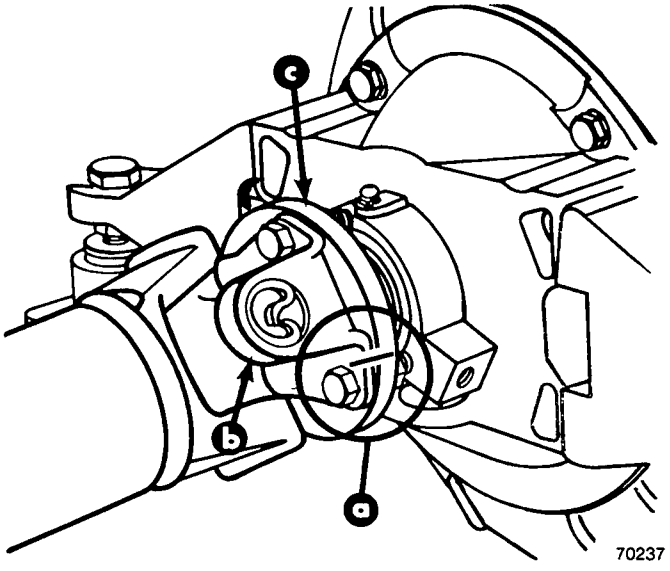
3. Disconnect and suitably plug fuel line, to prevent fuel in tank from leaking into bilge.
4. Disconnect throttle cable from carburetor and retain locknuts and hardware.
5. Disconnect bullet connectors of trim sender wires (coming from transom assembly) from engine harness or from terminal block (if so equipped) on circuit breaker/solenoid mounting bracket.
6. Slide sleeves back on black and white/green (or gray) wires and disconnect engine harness wires from shift cut-out switch harness.
7. Disconnect MerCathode wires from MerCathode controller if mounted on engine (some models).
8. Disconnect seawater inlet hose from engine.
9. Disconnect exhaust pipes from exhaust hoses.
10. Disconnect any grounding wire or accessories that are connected to engine.
11. **Power Steering Models:** Disconnect (and suitably plug) fluid hoses from power steering control valve on transom.
12. Remove top shield and then bottom shield drive shaft shields at engine end of extension drive shaft.



16300

a - Top Shield
b - Bottom Shield
c - 4 Screws/Nuts (2 Hidden)
d - 3 Screws (Hidden)

13. Mark extension drive shaft U-joint yoke/output flange connections at engine end (to assist in exact same positioning during assembly). Disconnect drive shaft from output flange.



70237

a - Matching Marks On Flange and Drive Shaft Connection
b - Extension Drive Shaft U-Joint Yoke
c - Flange, Output

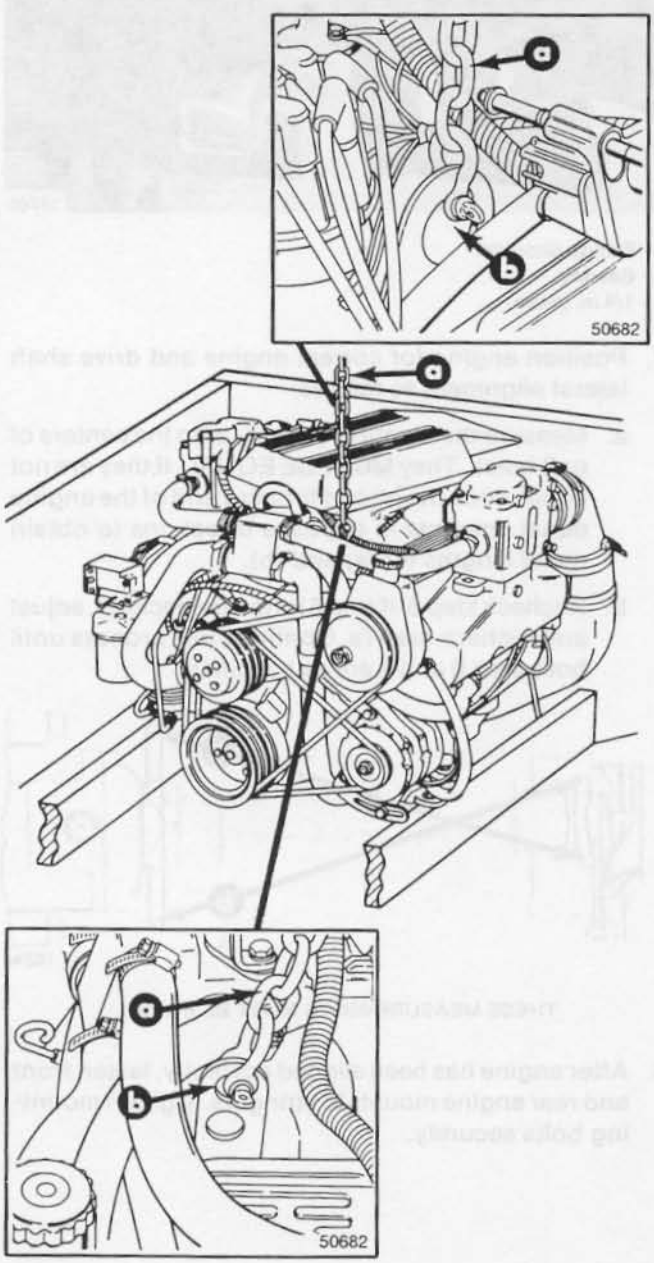
Engine End Shown

⚠CAUTION
Center lifting eye (located on top of thermostat housing) is used for engine alignment only. Do not use to lift entire engine.

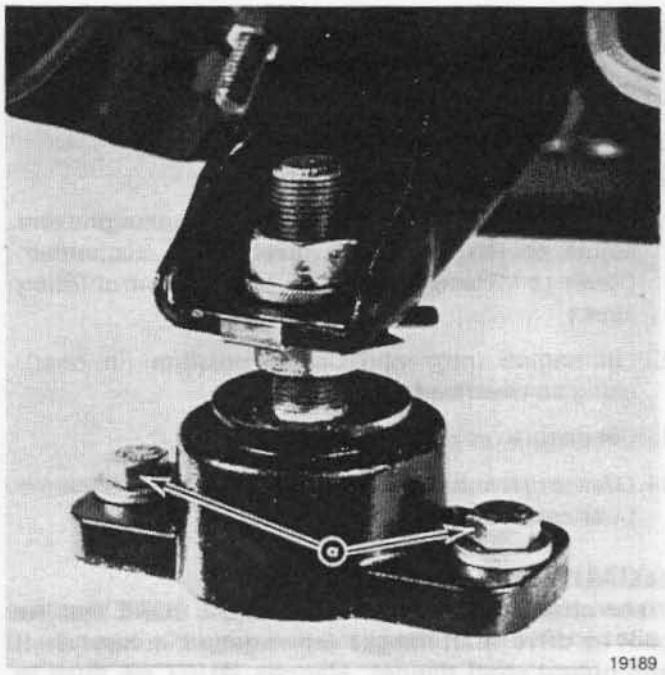
⚠CAUTION
Do not allow lifting sling to hook or compress engine components or damage will occur.

IMPORTANT: To avoid the need for a complete realignment (after engine repair), DO NOT MOVE FRONT AND REAR MOUNT ADJUSTMENT. Remove mounting bolts from boat stringers.

14. Support engine with suitable sling through lifting eyes on engine and remove front and rear engine mounting bolts from boat stringers. Retain hardware.



a - Suitable Sling
b - Engine Lifting Eyes



a - Mounting Bolts

Typical Mounting Shown

15. Carefully remove engine.

Installation

Engine Installation/Alignment

ENGINE MOUNT ADJUSTMENT WAS NOT DISTURBED DURING SERVICE

1. Attach a suitable sling to lifting eyes on engine and adjust so that engine is level when suspended. (Refer to "Removal" section for location of lifting eyes.)
2. Lift engine into approximate position (in boat), using an overhead hoist.
3. Set engine on stringers.
4. Grease drive shaft universal joints with 2-4-C Marine Lubricant.

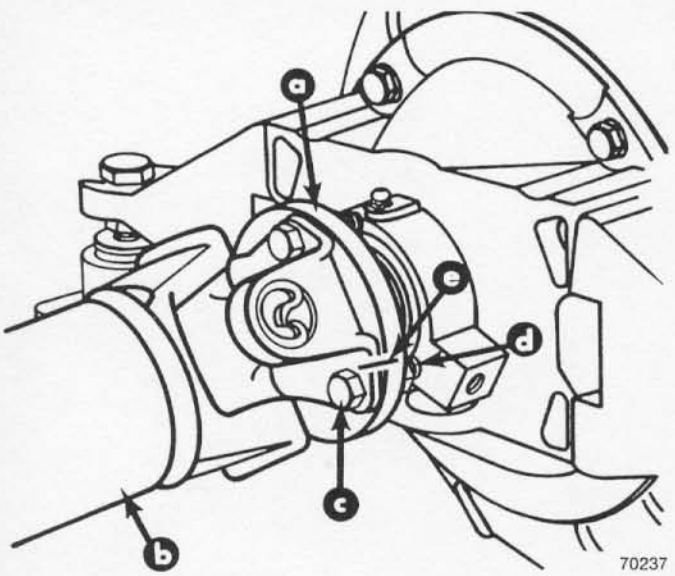
⚠CAUTION

When attaching shaft in next step, BE SURE that the pilot on drive shaft flanges are engaged in input shaft and output shaft flanges. Flanges MUST BE flush to each other prior to tightening screws or screws may come loose during operation.

⚠CAUTION

Failure to align shaft flanges with matching marks made on disassembly may cause improperly aligned drive unit and extension drive shaft U-joint centerlines resulting in a severe vibration problem.

5. As shown, attach engine output flange to drive shaft flange exactly as marked upon disassembly. Torque fasteners to 50 lb. ft. (68 N·m).



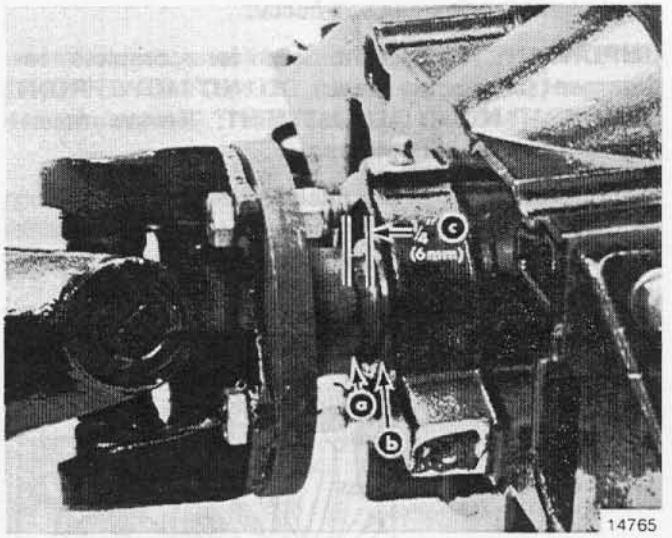
70237

a - Output Shaft Flange
b - Drive Shaft
c - Screw 7/16 in. - 20 x 1-1/2 in. (38mm) Long (4 Used)
d - Nut 7/16 in. - 20 (4 Used)
e - Matching Marks Made Upon Disassembly - Aligned

Engine End Shown

IMPORTANT: Failure to properly position output shaft flange may result in bearing damage.

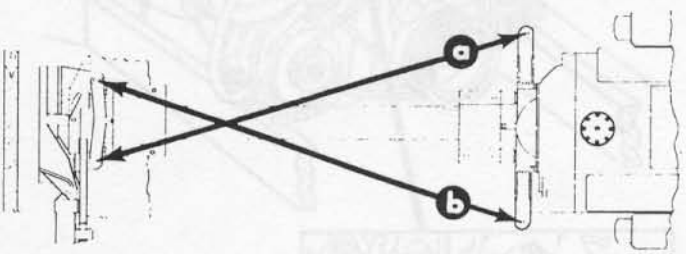
6. Relieve hoist tension from engine; then slide engine fore or aft as needed to obtain 1/4 in. (6mm) clearance between flange shoulder and extension shaft housing bearing.



14765

a - Flange Shoulder
b - Bearing
c - 1/4 in. (6mm)

7. Position engine for correct engine and drive shaft lateral alignment as follows:
   a. Measure the length of (a) and (b) to the centers of bolt holes. They MUST BE EQUAL. If they are not equal, slide the aft and forward end of the engine equal amounts in opposite directions to obtain equal lengths for (a) and (b).
   b. Recheck step 6. If step 6 is not as specified, adjust and recheck step 7a. Continue this process until both step 6 and 7 are as specified.

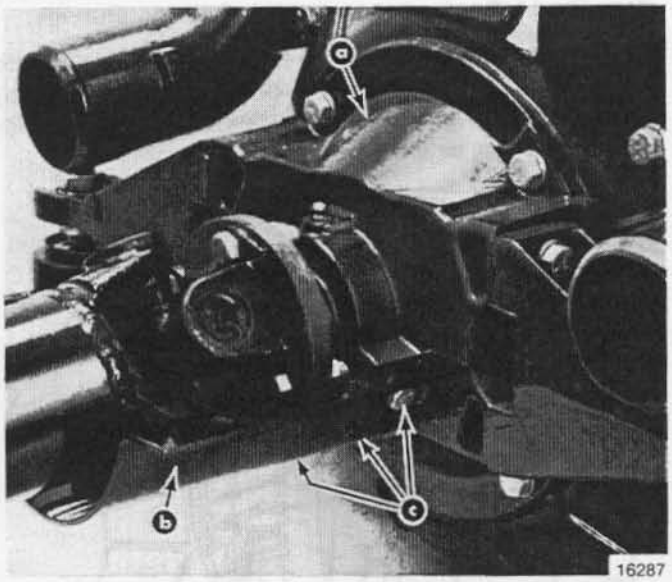


70246

THESE MEASUREMENTS **MUST BE EQUAL**

8. After engine has been aligned correctly, fasten front and rear engine mounts to stringers. Tighten mounting bolts securely.

9. Apply Loctite 271 to threads of bottom drive shaft shield retaining screws and install bottom shield on engine end as shown. Torque screws to 30 lb. ft. (41 N·m). Then install top shield. Torque screws and nuts to 30 lb. ft. (41 N·m).



16287

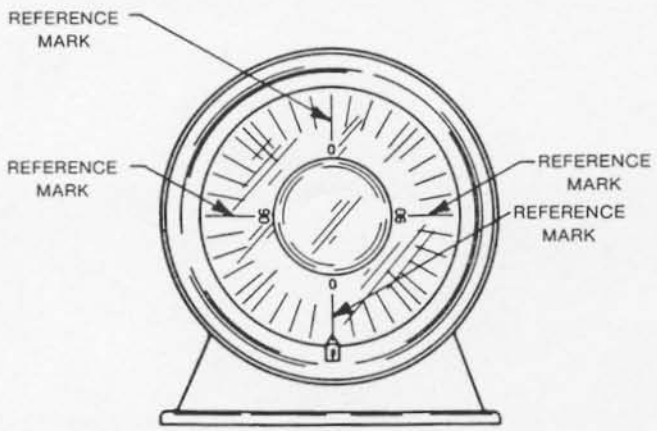
a - Shaft Housing
b - Bottom Shield
c - Screws [3 Used - Two Hidden In This View (Use Loctite 271)]

Engine End Shown

ENGINE MOUNT ADJUSTMENT WAS DISTURBED DURING SERVICE

NOTE: A Sears Craftsman Universal Protractor (stock number 9GT 3984) or equivalent is recommended for measuring the angles in the following steps.

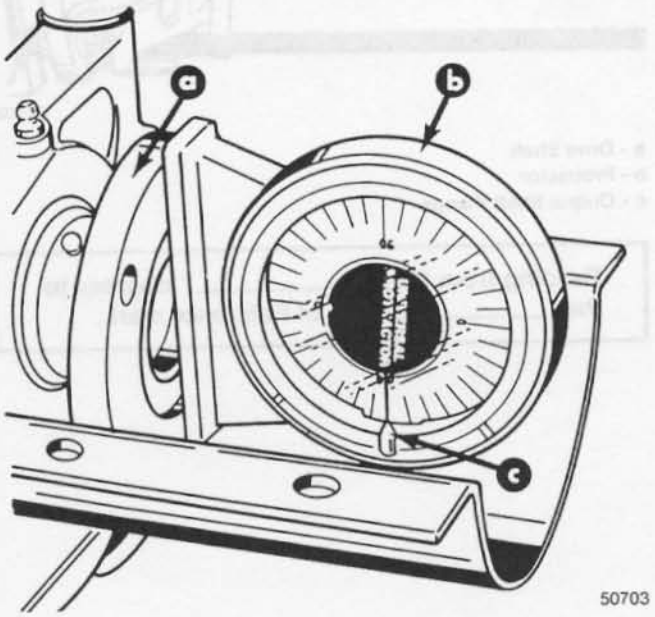
IMPORTANT: In the following steps, the protractor readings will be taken off of vertical and horizontal surfaces; therefore, both the 0° and the 90° marks will be used. It should be kept in mind that these are reference marks only and the assigned numbers should be ignored. It is only necessary to determine the number of degrees and to which side (left or right) of the reference marks the indicator needle rests. PROTRACTOR MUST BE VIEWED FROM THE SAME SIDE OF POWER PACKAGE THROUGHOUT INSTALLATION.



1. Refer to SECTION 8E - Drive Shaft Models/Propeller Shaft, and remove drive shaft.
2. Position base of protractor against input shaft flange, as shown. NOTE and RECORD the number of degrees and to which side of the reference mark the indicator needle has moved in the following chart.

Reading from Step 1. _____ degrees to the _____ side of Reference mark.

IMPORTANT: Be sure that boat does not move once reading has been taken from input shaft flange, as this reading establishes a reference point for aligning drive shaft and engine following. If boat is moved, reference point may be altered and subsequently, improper drive shaft and engine alignment may occur. Alignment tool MUST BE in place during entire alignment procedure, if drive unit is not installed.



50703

a - Input Shaft Flange
b - Protractor
c - Indicator Needle

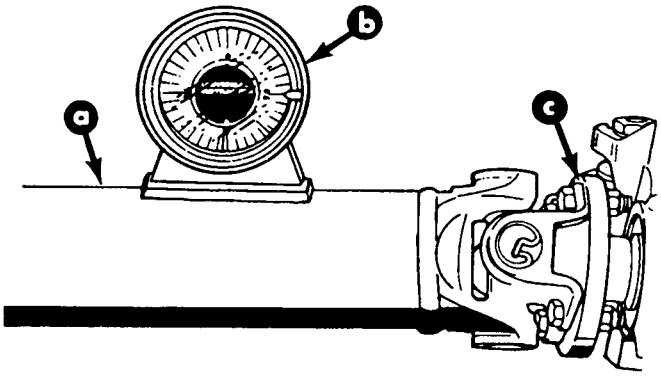
NOTE: For ease of installation we recommend the use of a chain leveler in the following steps.

3. Adjust engine mounts so that an equal amount of up and down adjustment exists.
4. Attach a suitable lifting chain to lifting eyes on engine and adjust so that engine will be level when suspended; then place engine into its approximate position (in boat) using an overhead hoist.
5. Refer to SECTION 8E - Drive Shaft Models/Propeller Shaft, and install drive shaft while observing precautions in SECTION 8E, especially about aligning gimbal bearing U-joint centerlines with extension drive shaft U-joint centerlines at bearing support input shaft. DO NOT install shields at this time.

⚠CAUTION

Engine MUST BE aligned correctly to achieve proper engine operation and to prevent damage to drive shaft. If drive shaft is run at an incorrect angle, damage to universal joint bearings may result.

6. Position base of protractor on drive shaft; then raise or lower engine (as boat construction permits) until indicator needle is 1° to 3° on either side of reading taken in Step 1. Record this reading in the following chart for later use.



70238

a - Drive Shaft
b - Protractor
c - Output Shaft Flange

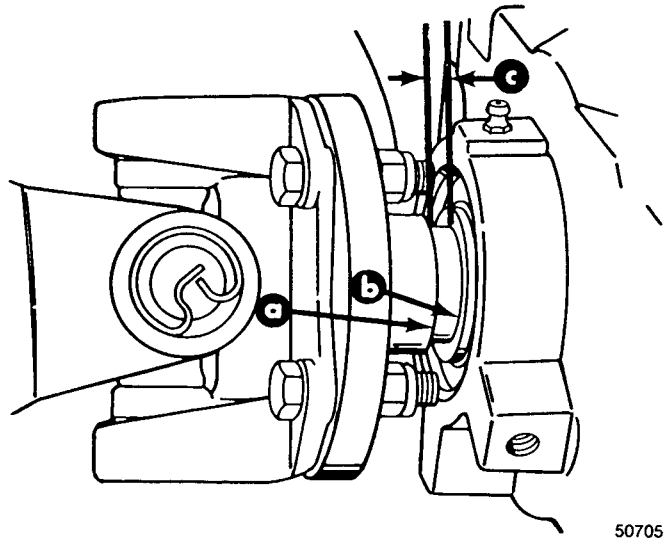
Reading from Step 6. _____ degrees to the _____ side of Reference mark.

7. Adjust stringer height so that the stringers just contact the engine mount bases.

⚠CAUTION

Failure to properly position output shaft flange (as described following) may result in bearing damage.

8. Relieve hoist tension from engine, then slide engine fore or aft as needed to obtain 1/4 in. (6.4mm) between flange shoulder and extension shaft housing bearing, as shown.



50705

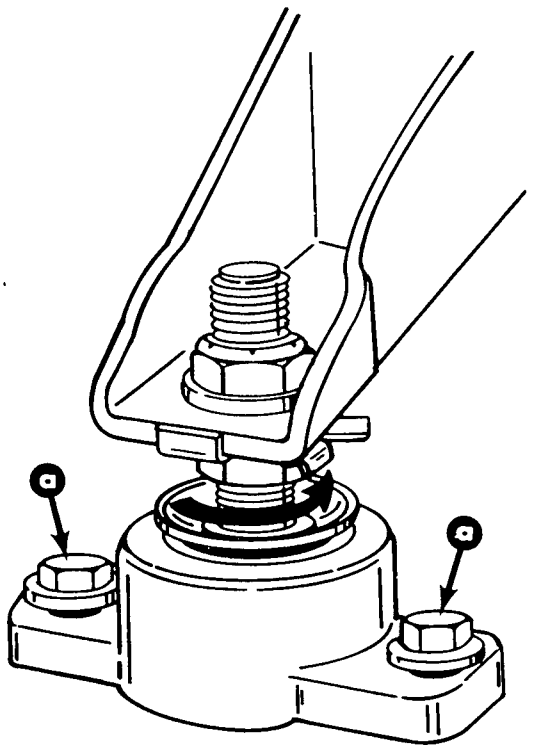
a - Flange Shoulder
b - Bearing
c - 1/4 in. (6mm)

9. Position engine for correct engine and drive shaft lateral alignment as follows:

   a. Measure the length of (a) and (b) to the centers of bolt holes. They MUST BE EQUAL. If they are not equal, slide the aft and forward end of the engine equal amounts in opposite directions to obtain equal lengths for (a) and (b).

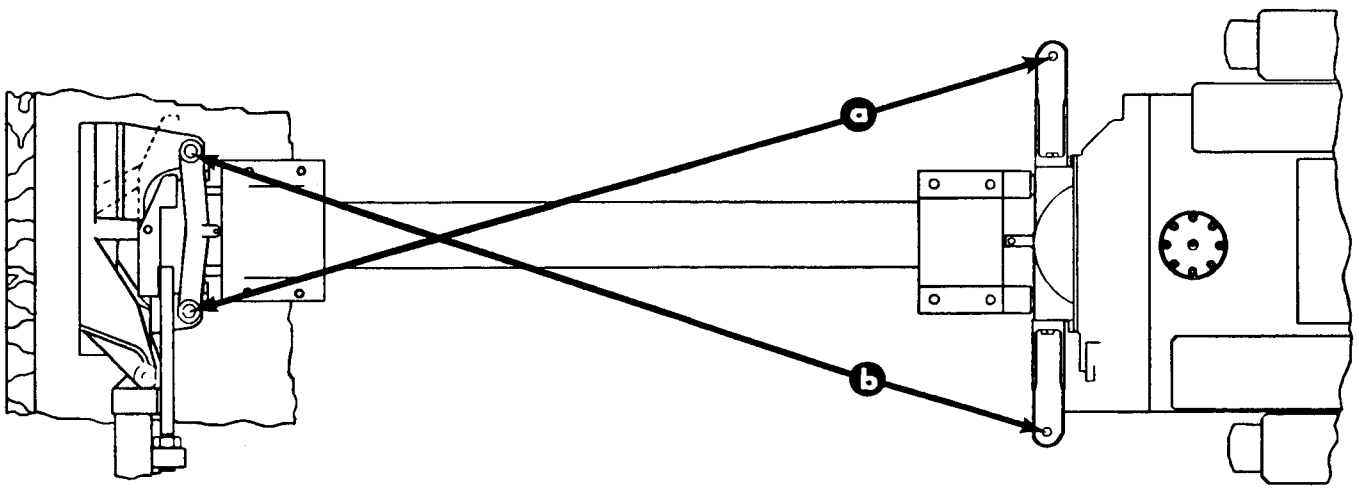
   b. Recheck step 8. If step 8 is not as specified, adjust and recheck step 9. Continue this process until both step 8 and 9 are as specified.

10. After engine has been aligned correctly, fasten front and rear engine mounts to stringers. Use 3/8 in. (9.5mm) diameter fasteners. Tighten securely.



22441

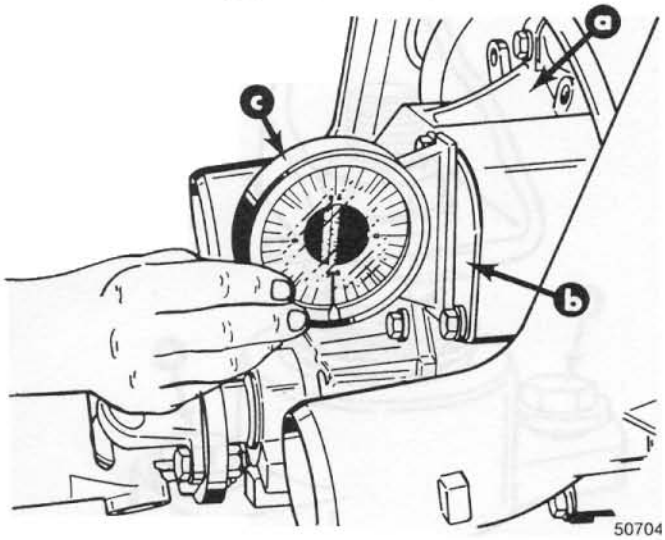
a - Fasteners



70246

THESE MEASUREMENTS **MUST BE EQUAL**

11. Position protractor on starter housing cover plate, as shown. Now, raise or lower front engine mount adjusting nuts as required so that protractor needle reads exactly the same number of degrees as that recorded in Step 1.

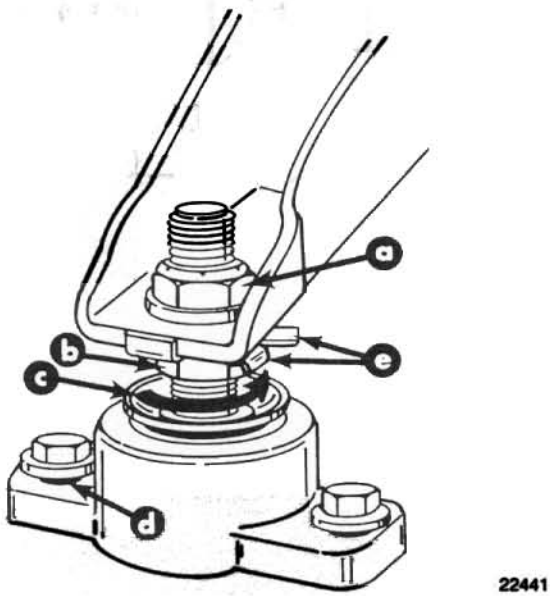


a - Flywheel Housing
b - Starter Housing Cover Plate
c - Protractor

Thru-Prop Exhaust Shown

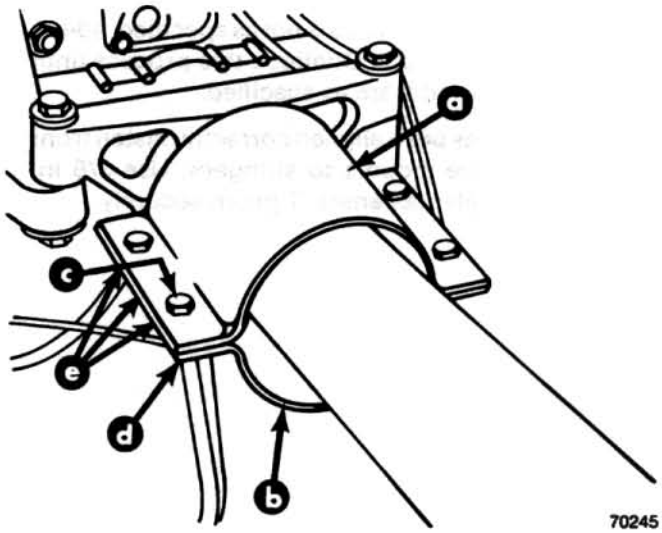
12. Position protractor on drive shaft and recheck angle. Angle should be the same as that recorded in Step 6. If not, raise or lower all 4 engine mount adjusting nuts an equal amount until correct angle is reached.

13. Tighten ALL engine mount nuts securely. Bend tab washer down on adjusting nut.



a - Nut and Lockwasher
b - Adjustment Nut
c - Turn Adjustment Nut in this Direction (Counterclockwise) to Raise Front of Engine
d - Slotted Hose Toward Front of Engine
e - Tab Washer

14. Apply Loctite 271 to threads of bottom drive shaft shield retaining screws and install bottom shields on engine and transom end as shown. Torque screws to 30 lb. ft. (41 N·m). Then install both top shields as shown. Torque screws and nuts to 30 lb. ft. (41 N·m).



a - Top Shield
b - Bottom Shield
c - Bolt [3/8 in. - 16 x 7/8 in. (22.2mm); 4 Used)
d - Nut (3/8 in. - 16; 4 Used)
e - Screws [3 Used - Hidden In This View (Use Loctite 271)]

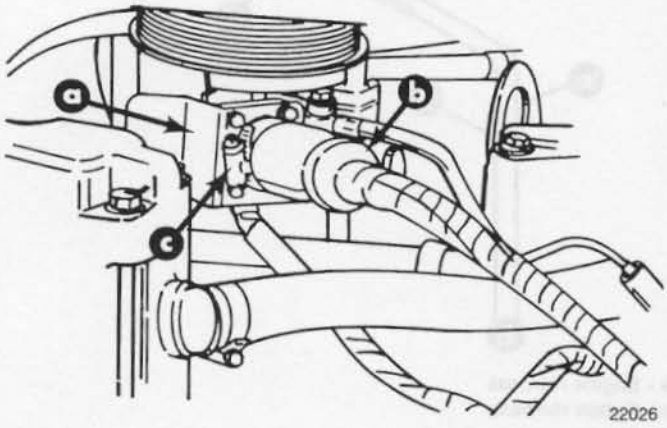
Top Shield and Bottom Shield At Transom End (Engine End Similar)

15. Proceed to "Engine Connections" section instructions following.

Engine Connections

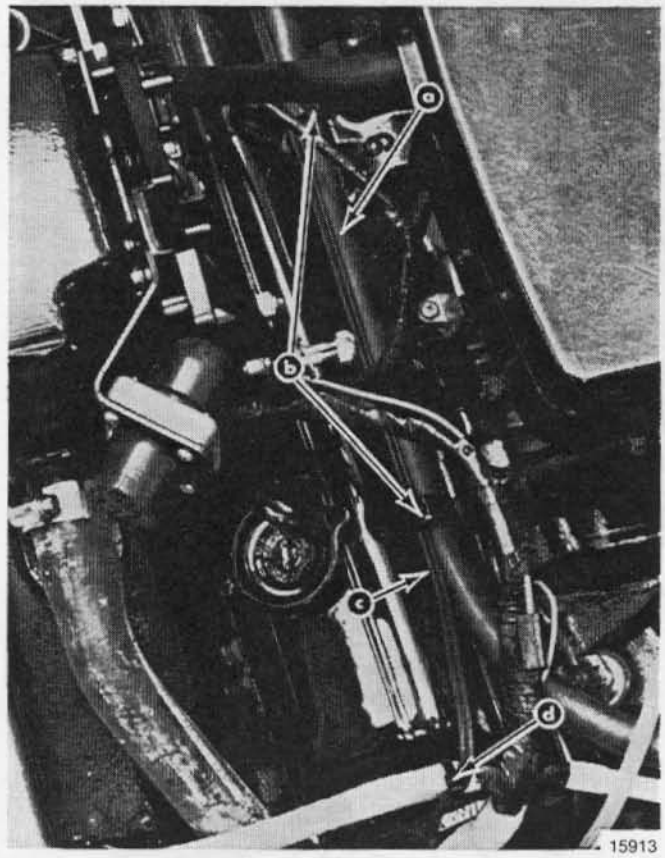
IMPORTANT: When routing all wire harnesses and hoses, be sure they are routed and secured to avoid coming in contact with hot spots on engine and avoid contact with moving parts.

1. Connect seawater inlet hose to engine. Tighten hose clamp securely.
2. Connect instrument harness to engine harness with hose clamp. Tighten clamp securely.



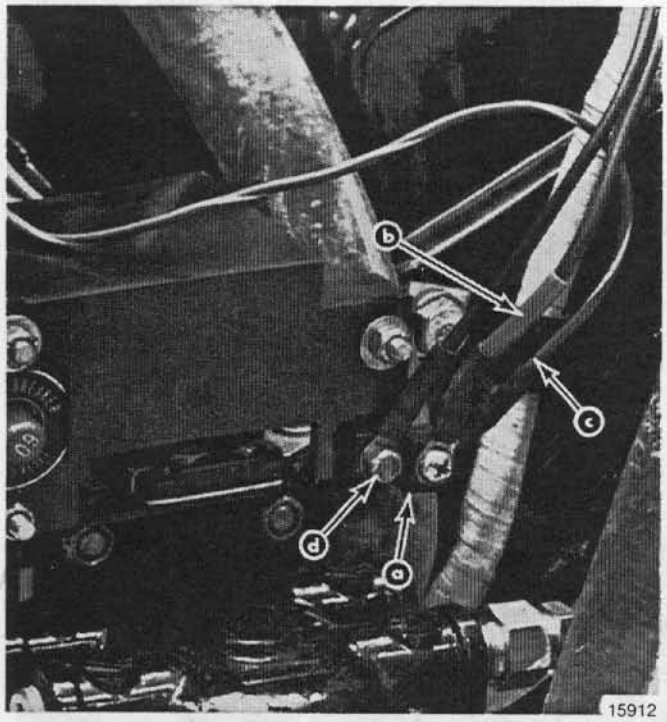
a - Engine Wiring Harness Receptacle Bracket
b - Instrumentation Wiring Harness Plug
c - Hose Clamp - Tighten Securely

3. Connect trim position sender wires following instructions "a" or "b":
   a. **On earlier engines with engine harness/trim sender wires attached at insulated terminal block:**
      (1) Route wires through hose clips on power steering hydraulic hose as shown. Use sta-straps as indicated.



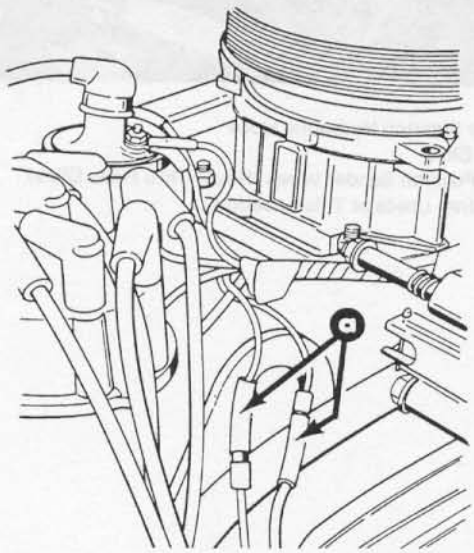
a - Power Steering Hydraulic Hose
b - Hose Clips
c - Trim Position Sender Wires (Route Thru Hose Clips)
d - Sta-Strap Leads at This Location

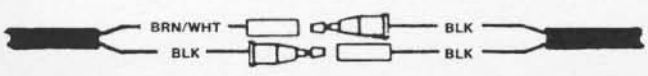
(2) Connect ring terminals to terminal block screws as shown, or connect bullet connectors to adaptors if so equipped (not shown).



a - Brown/White Wire - Route Thru Clamps That Hold the Power Steering Hoses. Then Connect to Insulated Terminal.

b. **On later engines with engine harness/trim sender wires with bullet connectors:** Connect sender wires to engine harness as shown.

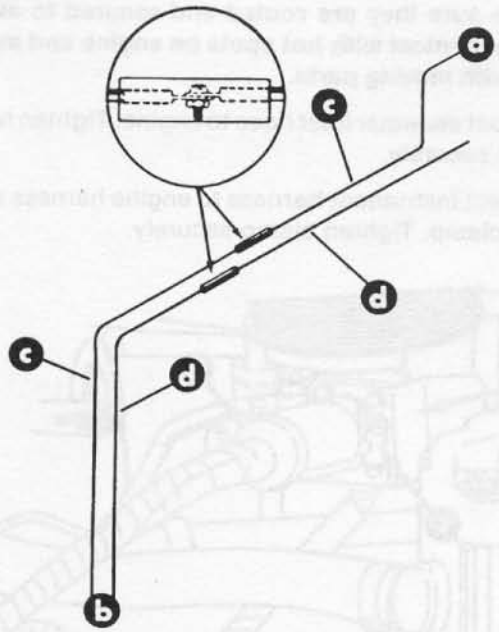




From Engine Harness From Transom Assembly

a - Engine Harness Bullet Connectors

4. Reconnect shift cut-out switch harness to engine harness.



a - Engine Harness
b - Switch Harness
c - Black
d - White-Green (or Gray)

⚠WARNING

Be careful when working on fuel system. Gasoline is extremely flammable and highly explosive under certain conditions. Do not smoke or allow spark or open flame in area. Wipe up any spilled fuel immediately.

5. Connect fuel line (from fuel tank) to engine. Make certain connection is secure. Check for leaks.

6. Connect throttle cable using hardware retained and adjust as follows:

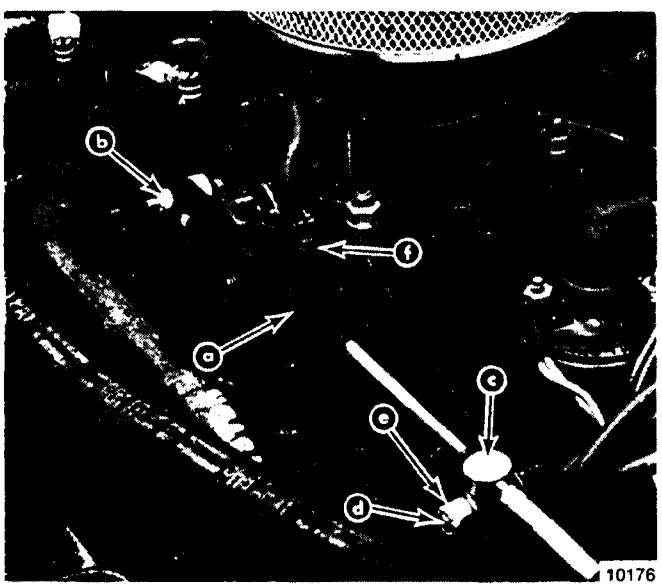
   a. Place remote control handle(s) in neutral, idle position.

IMPORTANT: Be sure that cable is routed in such a way as to avoid sharp bends and/or contact with moving parts. DO NOT fasten any items to throttle cable. Outer cable must be free to move when cable is actuated.

   b. Install cable end guide on throttle lever, then push cable barrel lightly toward throttle lever end. (This will place a slight preload on cable to avoid slack in cable when moving remote control lever.) Adjust barrel on throttle cable to align with anchor stud.

   c. Secure throttle cable with hardware (retained) as shown. Tighten cable end guide nut until it bottoms out and then back off 1 full turn. Tighten brass barrel securely. DO NOT OVER-TIGHTEN, as cable must pivot freely.

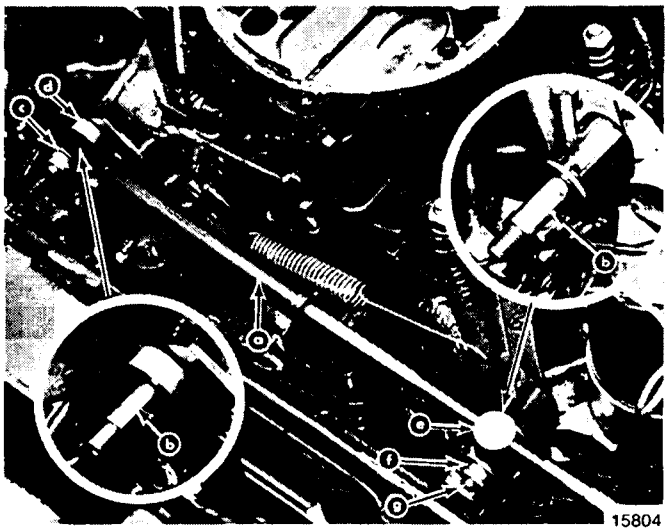
MODELS WITH 2 BARREL CARBURETOR



10176

a - Cable End Guide
b - Washer, Nut, Screw and Bushing (DO NOT Over-Tighten)
c - Brass Barrel
d - Stud
e - Washer and Nut (DO NOT Over-Tighten)
f - Idle Stop Screw

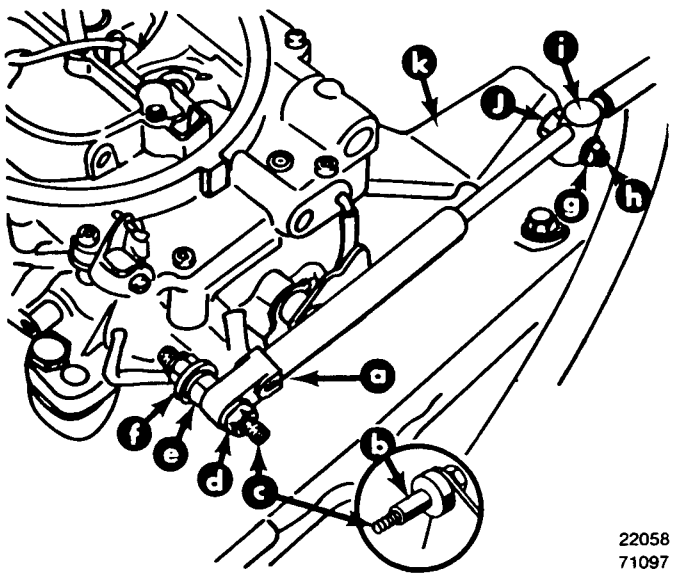
MODELS WITH 4 BARREL CARBURETOR



15804

a - Cable End Guide
b - Bushing
c - Washer, Nut and Screw (DO NOT Over-Tighten)
d - Spacer
e - Brass Barrel
f - Washer and Nut (DO NOT Over-Tighten)
g - Anchor Stud

Rochester Carburetor Shown



22058
71097

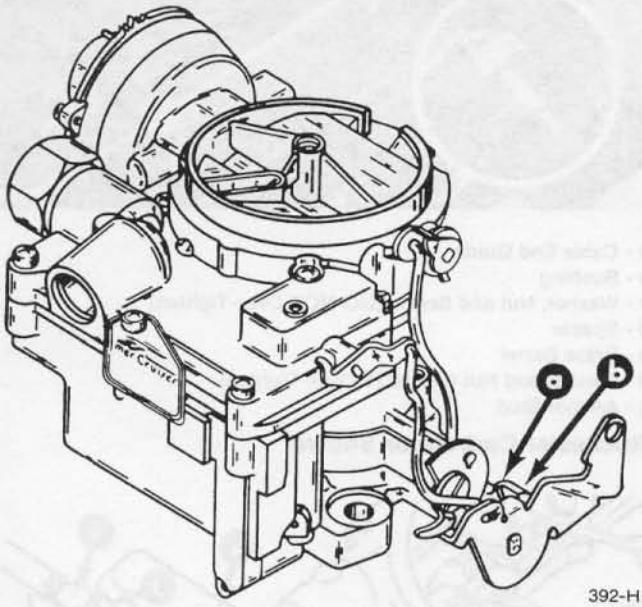
a - Cable End Guide
b - Bushing
c - Throttle Lever Stud
d - Locknut and Flat Washer - Tighten Until Nut Bottoms Out, Then Back Off 1 Full Turn
e - Spacer
f - Throttle Lever
g - Flat Washer and Locknut
h - Throttle Cable Anchor Stud
i - Cable Barrel
j - Flat Washer
k - Throttle Bracket

Weber Carburetor Shown

d. Place remote control throttle lever in the wide-open-throttle (W.O.T.) position. Check to ensure that throttle shutters (valves) are completely open and throttle shaft lever contacts carburetor body casting.

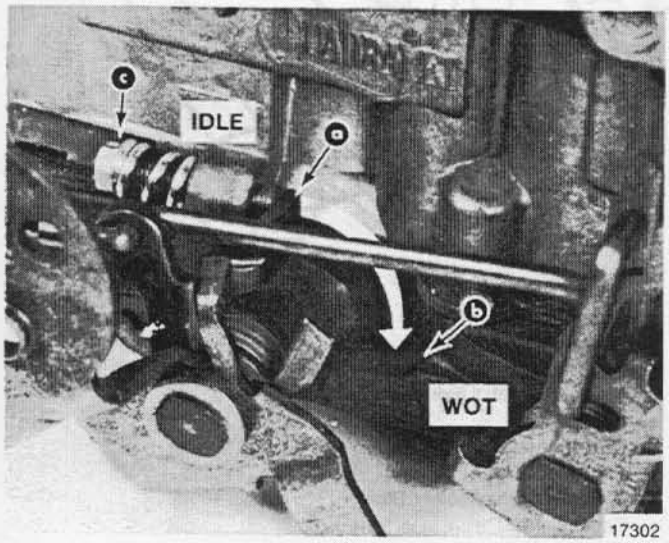
e. Return remote control throttle lever to idle position and check to ensure that throttle lever contacts idle speed adjustment screw.

MODELS WITH 2 BARREL CARBURETOR



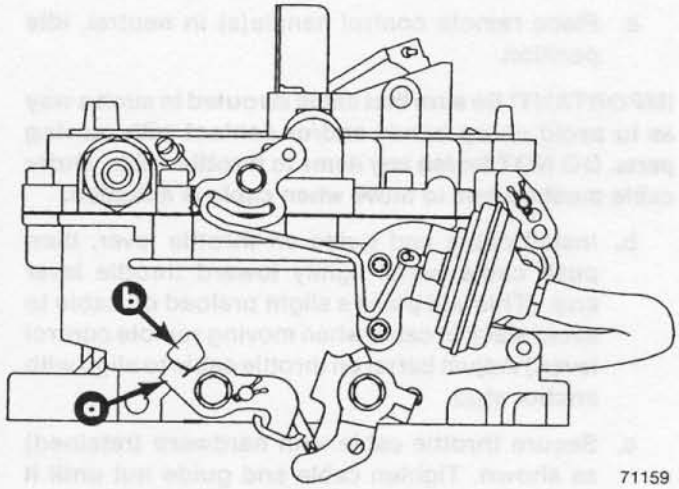
a - Throttle Lever Tang Against Stop
b - Idle Stop Screw

MODELS WITH ROCHESTER 4 BARREL CARBURETOR



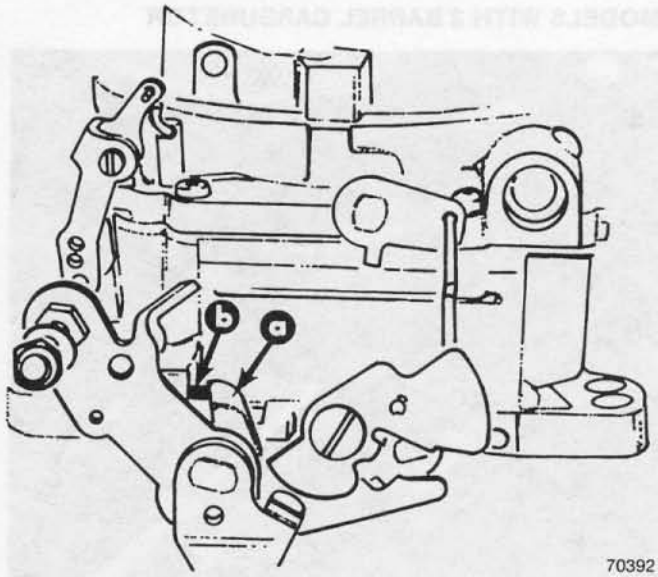
a - Tang
b - Carburetor Body
c - Idle RPM Adjustment Screw

MODELS WITH WEBER 4 BARREL CARBURETOR



a - Throttle Shaft Lever (Contacts "b" at W.O.T. Position)
b - Carburetor Body Casting

Wide-Open-Throttle Position Shown

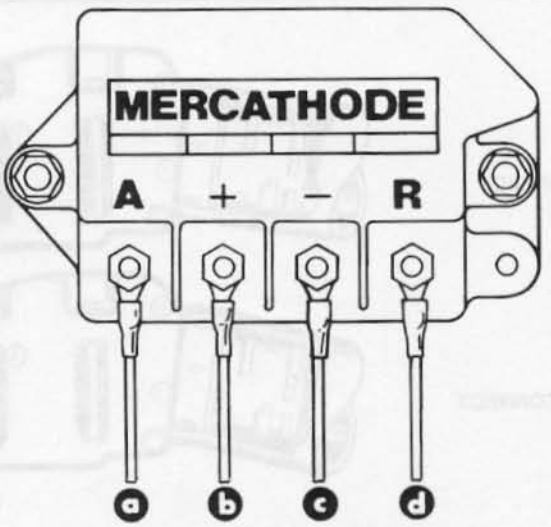


a - Throttle Lever (Contacts "b" in Idle Position)
b - Idle Speed Adjustment Screw

Idle Position Shown

IMPORTANT: Do not attach any accessory ground (-) wires to transom plate ground point. Accessory ground wires should only be attached to ground stud on engine.

7. Connect any grounding wires or accessories that may have been disconnected.
8. If previously disconnected, connect MerCathode wires to MerCathode controller assembly as shown. Apply a thin coat of Liquid Neoprene to all connections.



22232

a - Orange Wire - From Electrode on Transom Assembly
b - Red/Purple Wire - Connect (Other End) to Positive (+) Battery Terminal
c - Black Wire - From Engine Harness
d - Brown Wire - From Electrode on Transom Assembly

IMPORTANT: After fluid hose installation in the following, bleed power steering system as outlined in appropriate "Stern Drive Service Manual."

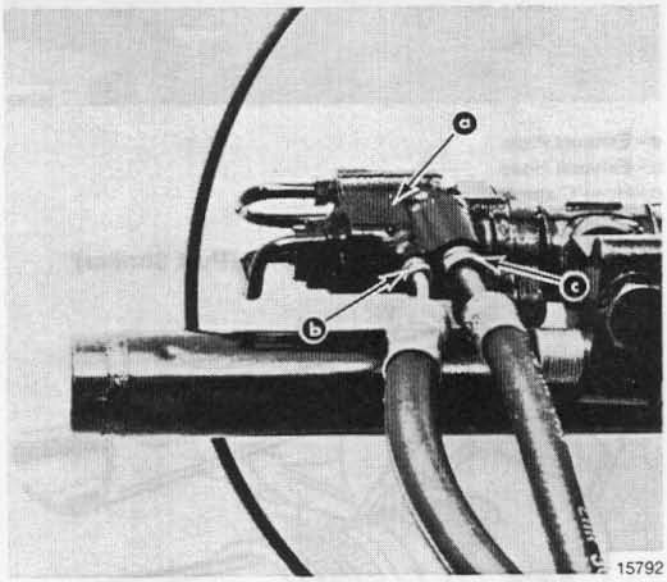
9. **Power Steering Models:** Connect power steering fluid hoses to control valve (large fitting first) as shown. Torque large fitting to 20-25 lb. ft. (27-34 N·m) and small fitting to 96-108 lb. in. (11-12 N·m).

⚠CAUTION

Route hoses exactly as shown below. This will help avoid stress on the hose fittings and will help avoid kinks in the hose.

IMPORTANT: Make hydraulic connections as quickly as possible to prevent fluid leakage.

IMPORTANT: Be careful not to cross-thread or overtighten fittings.

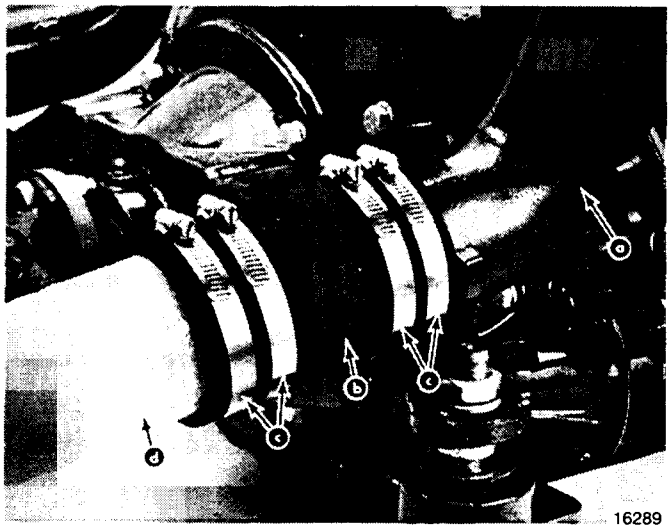


15792

a - Control Valve
b - Small Fitting
c - Large Fitting
Torque to Specifications

10. Using double hose clamps on all connections, install exhaust hoses and exhaust tubes as shown in "a" or "b" following. Tighten all hose clamps securely.

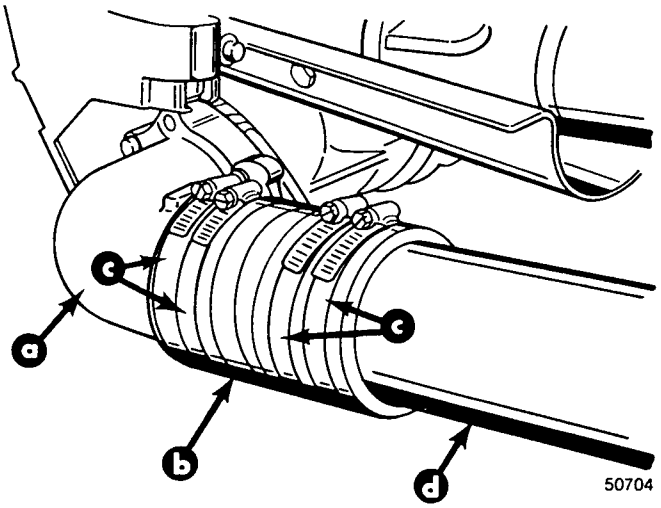
a. **On Engines With Thru-Prop Exhaust:**



16289

a - Exhaust Pipe
b - Exhaust Hose
c - Hose Clamps
d - Exhaust Tube

Starboard Side Engine End Shown (Port Similar)



50704

a - Exhaust Separator Assembly
b - Exhaust Hose
c - Hose Clamps
d - Exhaust Tube

Starboard Side Transom End Shown (Port Similar)

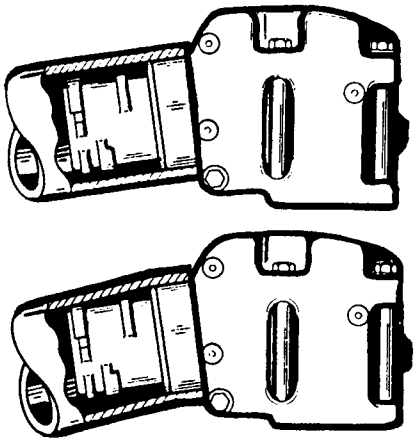
b. **On Engines With Thru-Transom Exhaust:**

NOTICE (THRU-TRANSOM EXHAUST)

Exhaust hoses must be connected to exhaust elbows so that they do not restrict the flow of discharge water from exhaust elbow. If hoses are connected incorrectly, discharge water from exhaust elbow will not flow around entire inside diameter of hose. This will cause a hot spot in the hose which may eventually burn thru.

CORRECT

INCORRECT


22032

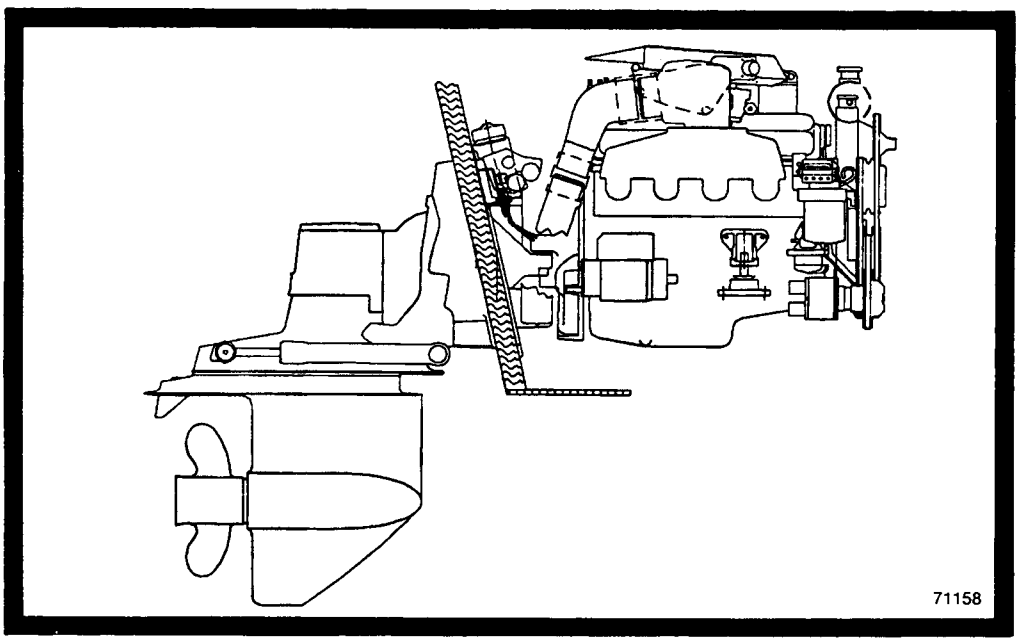
11. Connect battery cables to battery by FIRST connecting positive (+) battery cable (usually red) to positive (+) battery terminal. Tighten clamp securely. Then, connect negative (-) battery cable (usually black) to negative (-) battery terminal. Tighten clamp securely.

NOTE: Spray terminals with a battery connection sealant to help retard corrosion.

REMOVAL and INSTALLATION

2

C



MCM MODELS with BRAVO DRIVES

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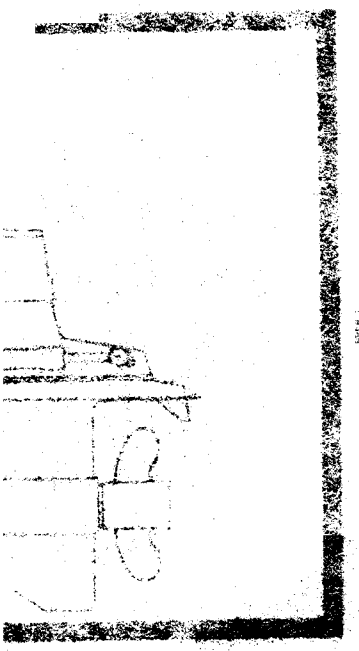


MCM MOD

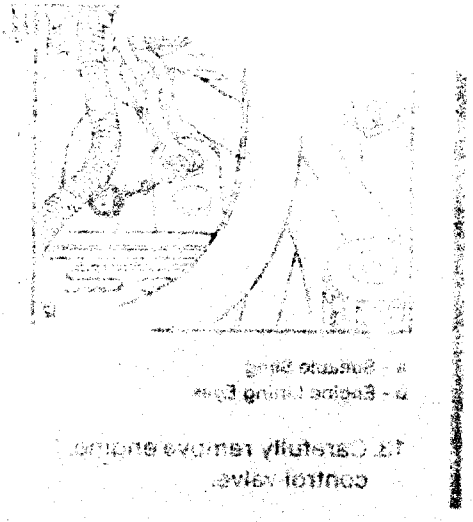
Torque Specifications

Fastener Location	Lb. Ft. (N·m)	Lb. In. (N·m)
Battery Cables	Securely	
Drive Unit Shift Cable		
Brass Barrel	Spread Cotter Pin	
Cable End Guide	(Note 1)	
Front Engine Mount	Securely	
Hose Clamps	Securely	
Power Steering Fluid Hose Fittings		
Large	20-25 (27-34)	
Small		96-108 (11-12)
Rear Engine Mounts	35-40 (47-54)	
Remote Control Shift Cable		
Brass Barrel	Securely	
Cable End Guide	(Note 1)	
Remote Control Throttle Cable		
Brass Barrel	Securely	
Cable End Guide	(Note 1)	

NOTE: Tighten, then back nut off 1 full turn.

Tools/Lubricants/Adhesives/Sealants

Part Number	Description
91-57797A3	Engine Alignment Tool
91-816391A4	Engine Coupler Spline Grease
92-25711--1	Liquid Neoprene
Obtain Locally	Loctite Pipe Sealant with Teflon



Removal

IMPORTANT: Stern drive unit must be removed prior to engine removal. Refer to "Stern Drive Service Manual."

1. Disconnect battery cables from battery.
2. Remove instrument harness connector plug from engine harness receptacle after loosening clamp.

⚠WARNING

Be careful when working on fuel system. Gasoline is extremely flammable and highly explosive under certain conditions. Do not smoke or allow spark or open flame in area. Wipe up any spilled fuel immediately.

3. Disconnect and suitably plug fuel line, to prevent fuel in tank from leaking into bilge.
4. Disconnect throttle cable from carburetor and retain locknuts and hardware.
5. Disconnect trim position sender wires (coming from transom assembly) following instructions appropriate to your installation:
   a. Disconnect bullet connectors of trim sender wires from engine harness.
   b. Remove screw and nut on MerCathode controller assembly (if so equipped and on engine) and disconnect trim sender wire terminals.

NOTE: After wires are disconnected be sure to loosen them from clamps or sta-straps retaining them to engine or hoses.

6. Disconnect MerCathode wires from MerCathode controller on engine (some models).
7. Disconnect seawater inlet hose from gimbal housing.
8. Disconnect exhaust elbow hoses (bellows).
9. Remove both shift cables from shift plate. Retain locknuts and hardware.
10. Disconnect any grounding wire or accessories that are connected to engine.
11. **Power Steering Models:** Disconnect (and suitably plug) fluid hoses from power steering control valve on transom.

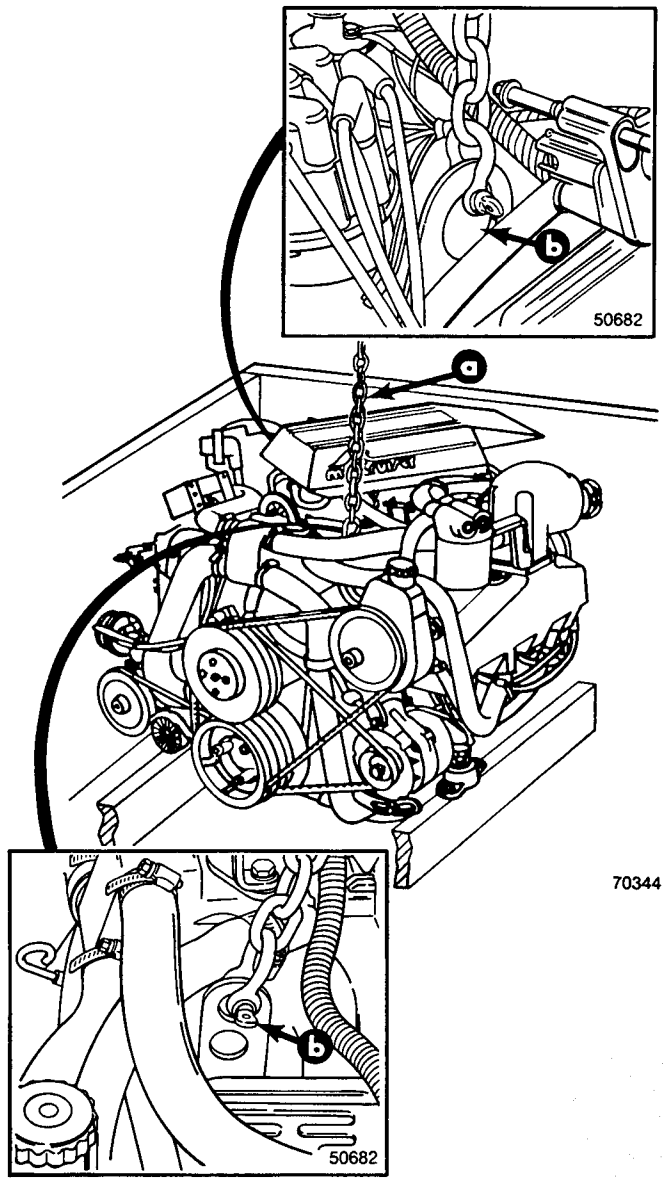
⚠CAUTION

Center lifting eye (located on top of thermostat housing) is used for engine alignment only. Do not use to lift entire engine.

⚠CAUTION

Do not allow lifting device to hook or compress engine components or damage will occur.

12. Support engine with suitable sling through lifting eyes on engine and remove front and rear engine mounting bolts. Retain hardware.



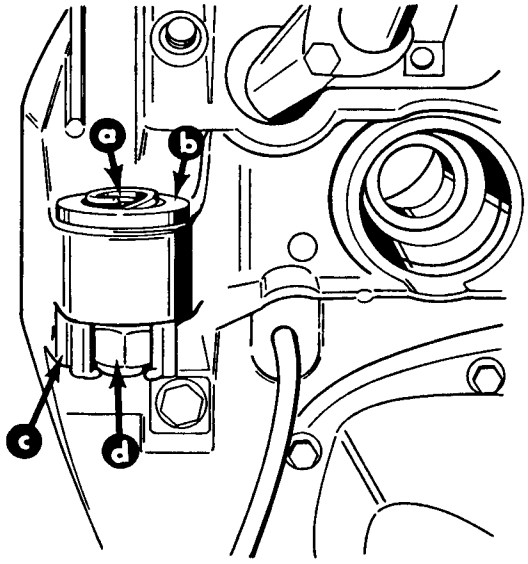
a - Suitable Sling
b - Engine Lifting Eyes

13. Carefully remove engine. Do not hit power steering control valve.

Installation

Engine Installation/Alignment

1. Follow instructions "a" - "e":
   a. Be certain fiber washers (cemented in place) on inner transom plate are present. Inspect fiber washers. Replace if worn or damaged.
   b. Install double wound lockwashers onto inner transom plate inside fiber washer.
   c. Be certain rear engine mount locknuts are in position as shown.
   d. Lubricate exhaust bellows with soap/water to ease installation.
   e. Lubricate engine coupler splines with Quicksilver Engine Coupler Spline Grease 92-816391A4.



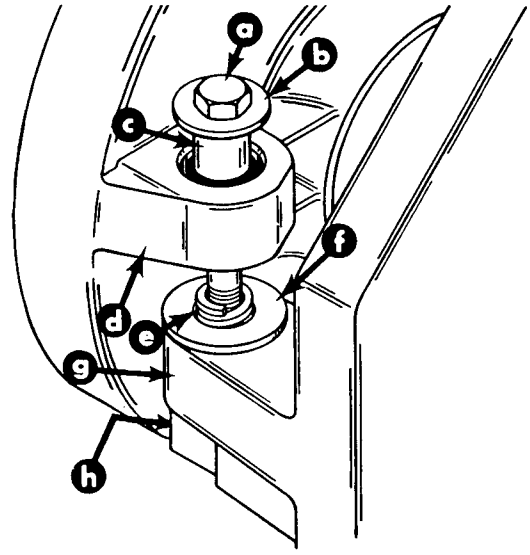
50628

a - Double Wound Lockwasher
b - Fiber Washer (Cemented in Place)
c - Inner Transom Plate Mount (Engine Support)
d - Locknuts (Engine Mounting Bolts)

2. Attach a suitable sling to lifting eyes on engine and adjust so that engine is level when suspended. (Refer to "Removal" section for location of lifting eyes.)
3. Lift engine into position (in boat), using an overhead hoist.
4. Align rear engine mounts with inner transom plate mounts while simultaneously aligning exhaust tubes with exhaust pipe hoses (bellows).

IMPORTANT: Engine attaching hardware must be installed in sequence shown.

5. Install both rear engine mounting bolts and hardware as shown. Torque to 35-40 lb. ft. (47-54 N·m).



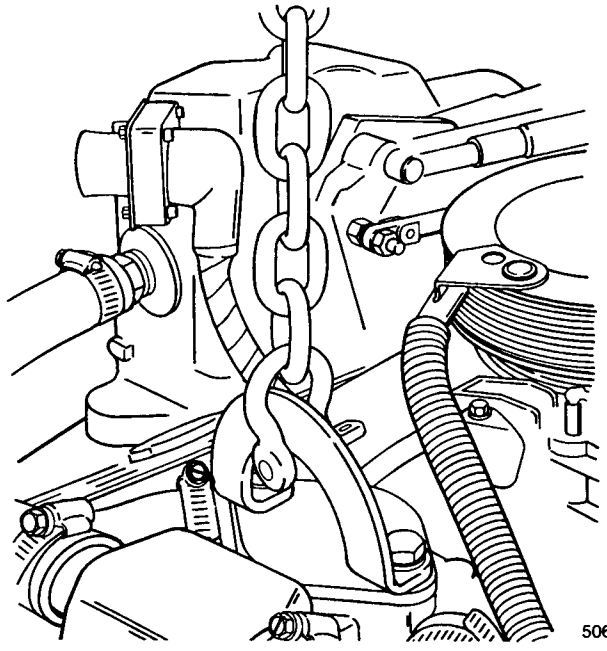
22032

a - Bolt, Rear Engine Mounting
b - Washer, Large Steel
c - Spacer, Metal
d - Rear Engine Mount
e - Double Wound Lockwasher
f - Fiber Washer
g - Inner Transom Plate Mounts
h - Locknut (Hidden In This View)

⚠CAUTION

When lowering engine into position DO NOT set engine on shift cable. Shift cable outer casing can be crushed causing difficult or improper shifting.

6. Set engine down on stringers and relieve hoist tension. Disconnect sling from engine lifting eyes and switch sling to center lifting eye.



50682

7. Align engine as follows:

⚠CAUTION

DO NOT use an alignment tool from another manufacturer. Alignment tools other than Quicksilver Alignment Tool 91-57797A3, may cause improper alignment and damage to gimbal bearing and/or engine coupler.

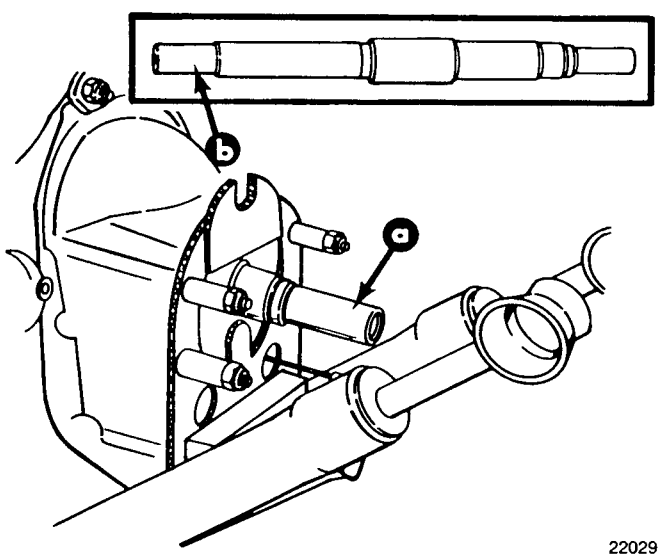
⚠CAUTION

To avoid damage to gimbal bearing, engine coupler, or alignment tool:

- **DO NOT attempt to force alignment tool!**
- **DO NOT raise or lower engine with alignment tool inserted (or partially inserted) in gimbal bearing or engine coupler.**

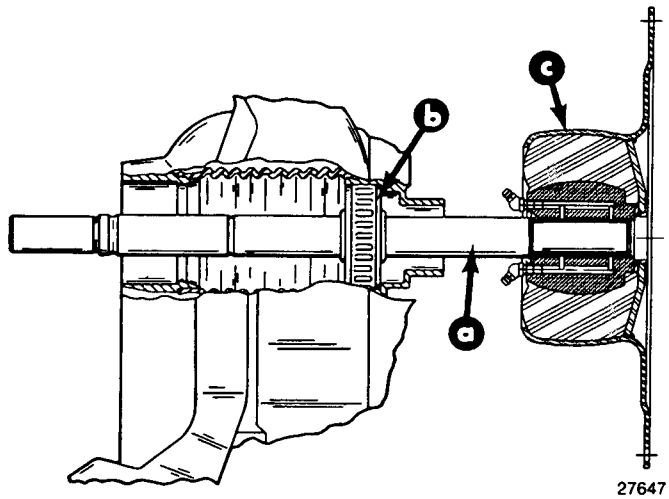
a. Attempt to insert solid end of Quicksilver Alignment Tool 91-57797A3 through gimbal bearing and into engine coupler splines. If it will not insert easily proceed to following.

b. While observing the above precautions, **CAREFULLY** raise and lower front of engine with hoist, as required, until tool will **SLIDE FREELY** all the way in and out of engine coupler splines.



22029

a - Alignment Tool (Use Only Quicksilver Alignment Tool - Part Number 91-57797A3)
b - Insert This End of Alignment Tool through Gimbal Housing Assembly



27647

a - Alignment Tool
b - Gimbal Bearing
c - Engine Coupler

IMPORTANT: Turn both front engine mount adjustment nuts an equal amount in direction required to align engine.

c. Adjust front engine mounts until they rest on boat stringers.

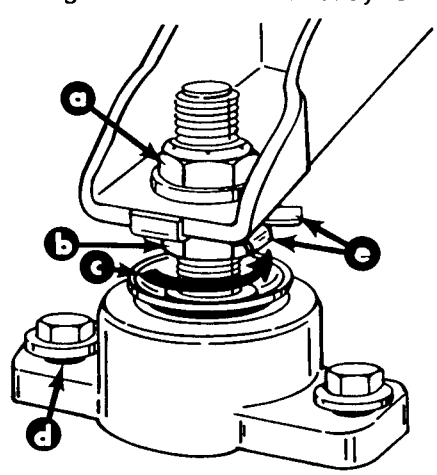
d. Relieve hoist tension entirely and fasten both front mounts to boat stringer using appropriate hardware (lag bolts or thru-bolts, etc.).

e. Recheck alignment with alignment tool. Tool must enter coupler splines freely. If not readjust front mounts.

f. When alignment is correct, tighten locknut or nut with lockwasher on each mount securely.

g. Bend tab washer down against flat on adjusting nut.

h. Remove alignment tool if not already removed.

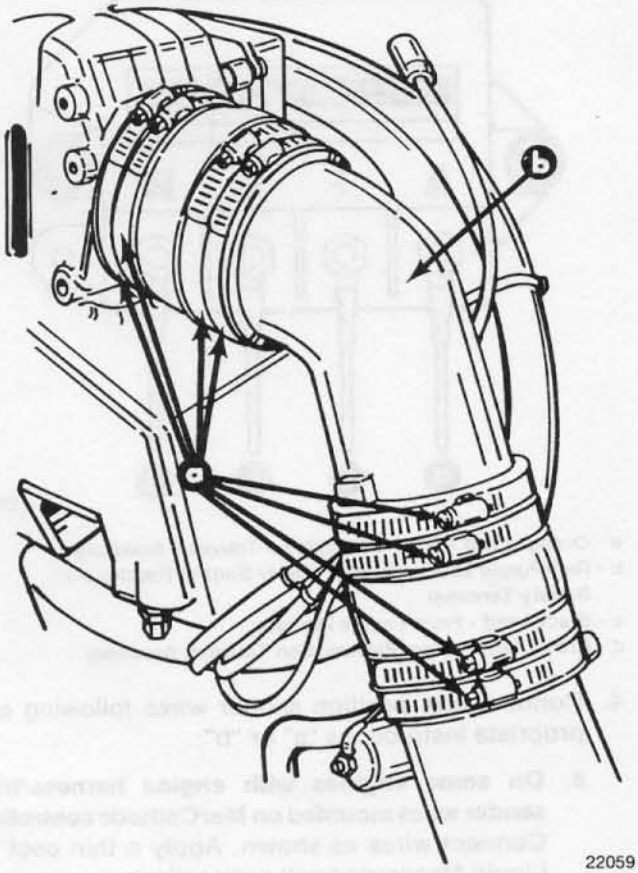


22441

a - Locknut
b - Adjustment Nut
c - Turn Adjustment Nut in this Direction (Counterclockwise) to Raise Front of Engine
d - Slotted Hole Toward Front of Engine. Attach Mounts to Stringers as Follows:
V8 Engines — Use 1/2 in. (13mm) Lag Bolts
e - Tab Washer

8. Tighten all exhaust system hose clamps securely as follows (use two hose clamps on each connection):

   a. **On Engines With Thru-Prop Exhaust:**



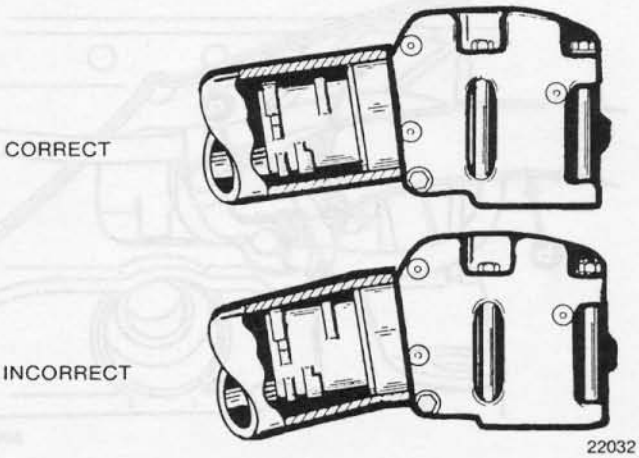
22059

a - Hose Clamps - Tighten Securely
b - Exhaust Tube - Long Tube, Port Side
- Short Tube, Starboard Side

   b. **On Engines With Thru-Transom Exhaust:**

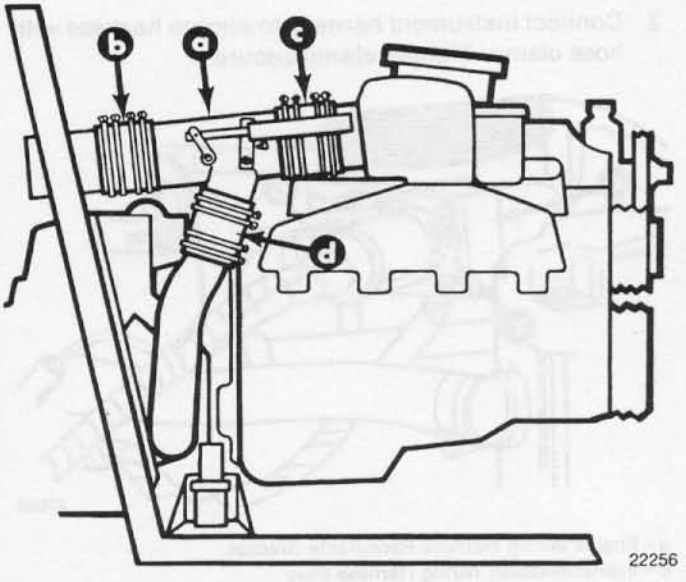
NOTICE (THRU-TRANSOM EXHAUST)

Exhaust hoses must be connected to exhaust elbows so that they do not restrict the flow of discharge water from exhaust elbow. If hoses are connected incorrectly, discharge water from exhaust elbow will not flow around entire inside diameter of hose. This will cause a hot spot in the hose which may eventually burn thru.



22032

   c. **On Engines With Silent Choice Exhaust:**



22256

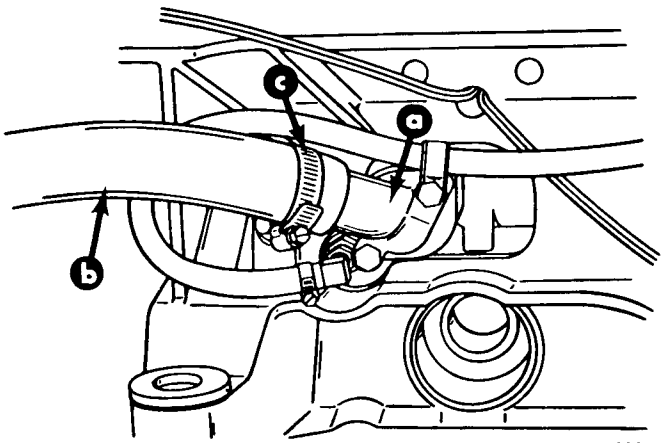
a - Silencer Valve
b - Exhaust Hose and Clamps for Thru-Transom
c - Exhaust Hose and Clamps for Intermediate Exhaust Pipe
d - Exhaust Hose and Clamps for Exhaust Pipe

Engine Connections

IMPORTANT: When routing all wire harnesses and hoses, be sure they are routed and secured to avoid coming in contact with hot spots on engine and avoid contact with moving parts.

1. Connect seawater hose to water tube at gimbal housing with hose clamp. Tighten clamp securely.

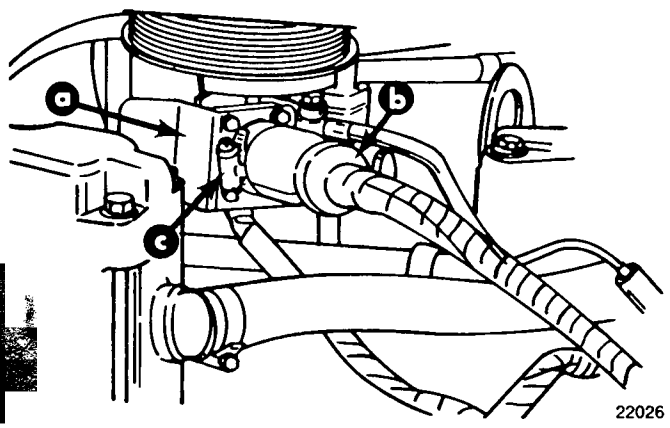
NOTE: In the following view the engine is not in position, for visual clarity in this step.



50664

a - Water Inlet Tube
b - Hose Clamp
c - Seawater Inlet Hose

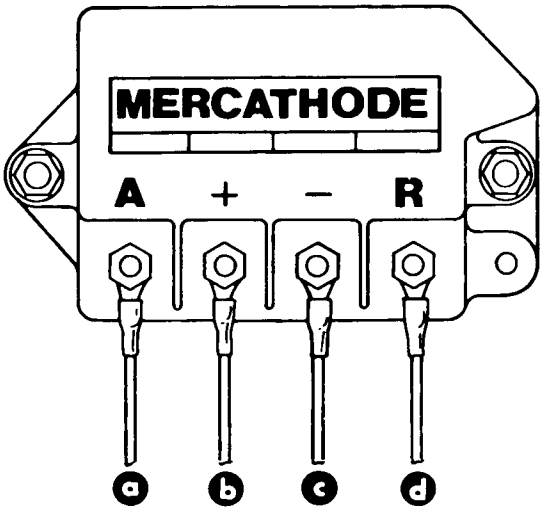
2. Connect instrument harness to engine harness with hose clamp. Tighten clamp securely.



22026

a - Engine Wiring Harness Receptacle Bracket
b - Instrumentation Wiring Harness Plug
c - Hose Clamp - Tighten Securely

3. **Models With MerCathode:** Connect wires to MerCathode controller assembly as shown. Apply a thin coat of Liquid Neoprene to all connections.

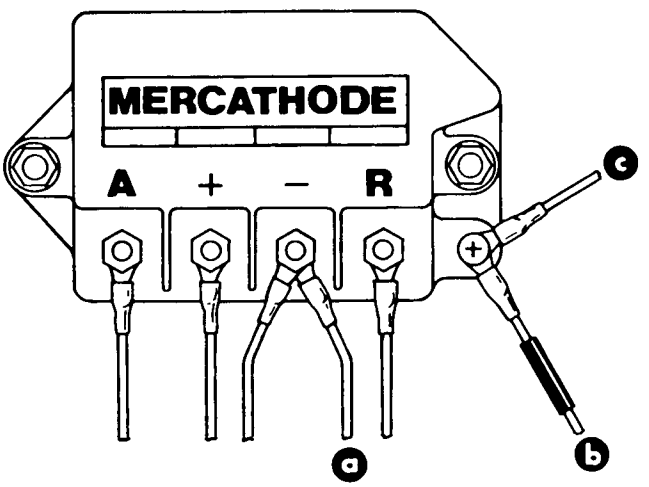


22232

a - Orange Lead - From Electrode on Transom Assembly
b - Red/Purple Lead - Connect (Other End) to Positive (+) Battery Terminal
c - Black Lead - From Engine Harness
d - Brown Lead - From Electrode on Transom Assembly

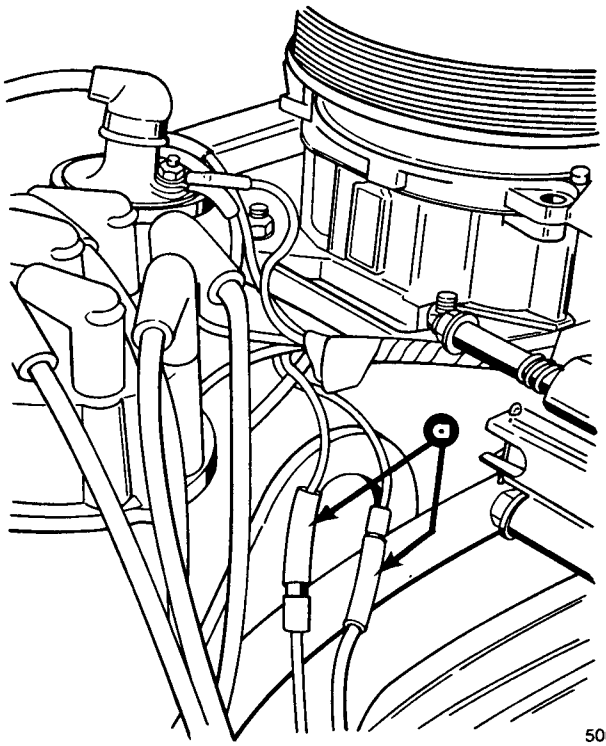
4. Connect trim position sender wires following appropriate instructions "a" or "b":

   a. **On some engines with engine harness/trim sender wires mounted on MerCathode controller:** Connect wires as shown. Apply a thin coat of Liquid Neoprene to all connections.

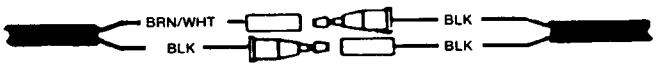


a - Trim Position Sender Lead **Without** Sleeve
b - Trim Sender Lead With Brown or Purple Sleeve
c - Brown/White Lead - From Engine Harness

b. **On later engines with engine harness/trim sender wires with bullet connectors:** Connect sender wires to engine harness as shown.



50681



From Engine Harness — From Transom Assembly

a - Engine Harness Bullet Connectors

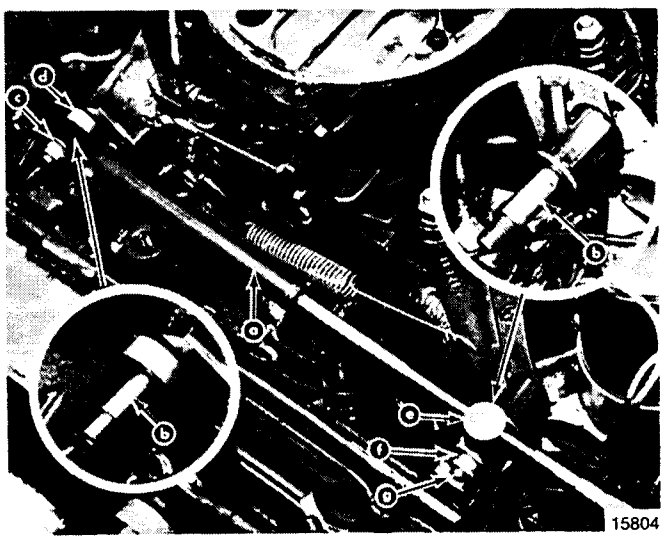
⚠WARNING

Be careful when working on fuel system. Gasoline is extremely flammable and highly explosive under certain conditions. Do not smoke or allow spark or open flame in area. Wipe up any spilled fuel immediately.

5. Connect fuel line (from fuel tank) to engine. Make certain connection is secure. Check for leaks.
6. Connect throttle cable using hardware retained and adjust as follows:
   a. Place remote control handle(s) in neutral, idle position.

IMPORTANT: Be sure that cable is routed in such a way as to avoid sharp bends and/or contact with moving parts. DO NOT fasten any items to throttle cable. Outer cable must be free to move when cable is actuated.

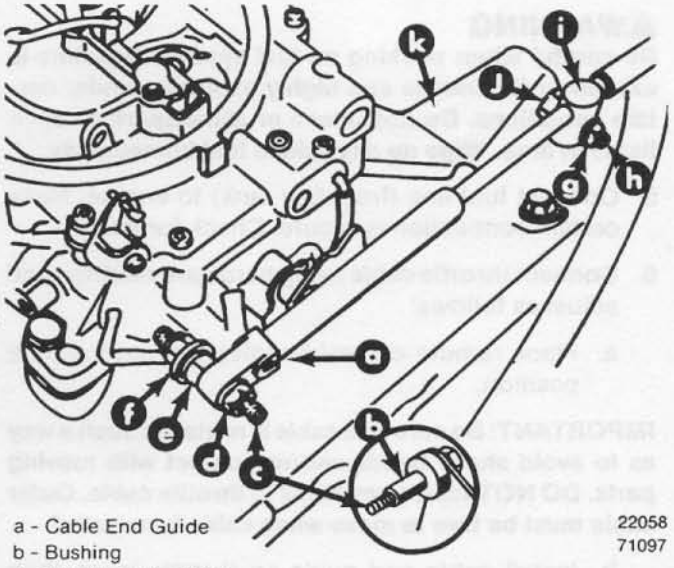
   b. Install cable end guide on throttle lever, then push cable barrel lightly toward throttle lever end. (This will place a slight preload on cable to avoid slack in cable when moving remote control lever.) Adjust barrel on throttle cable to align with anchor stud.
   c. Secure throttle cable with hardware (retained) as shown. Tighten cable end guide nut until it bottoms out and then back off 1 full turn. Tighten brass barrel securely. DO NOT OVER-TIGHTEN, as cable must pivot freely.



15804

a - Cable End Guide
b - Bushing
c - Washer, Nut and Screw (DO NOT Over-Tighten)
d - Spacer
e - Brass Barrel
f - Washer and Nut (DO NOT Over-Tighten)
g - Anchor Stud

Rochester Carburetor Shown (Weber Similar)



22058
71097

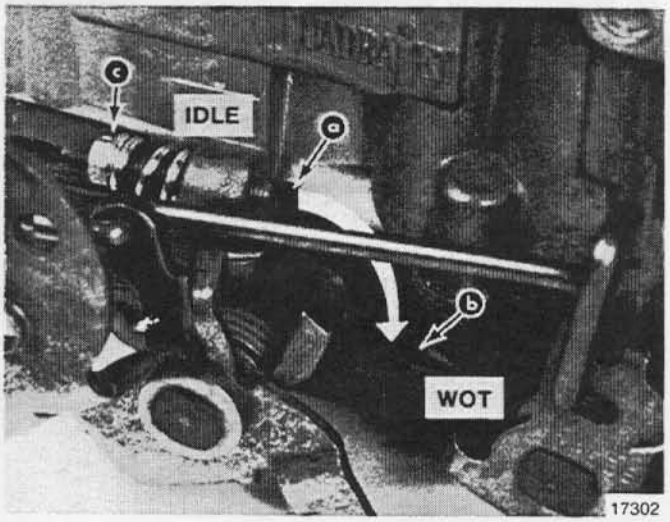
a - Cable End Guide
b - Bushing
c - Throttle Lever Stud
d - Locknut and Flat Washer - Tighten Until Nut Bottoms Out, Then Back Off 1 Full Turn
e - Spacer
f - Throttle Lever
g - Flat Washer and Locknut
h - Throttle Cable Anchor Stud
i - Cable Barrel
j - Flat Washer
k - Throttle Bracket

Weber Carburetor Shown

d. Place remote control throttle lever in the wide-open-throttle (W.O.T.) position. Check to ensure that throttle shutters (valves) are completely open and throttle shaft lever contacts carburetor body casting.

e. Return remote control throttle lever to idle position and check to ensure that throttle lever contacts idle speed adjustment screw.

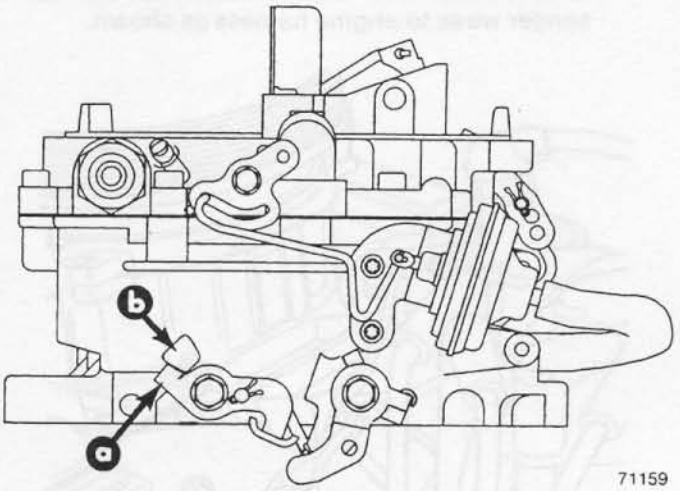
MODELS WITH ROCHESTER 4 BARREL CARBURETOR



17302

a - Tang
b - Carburetor Body
c - Idle RPM Adjustment Screw

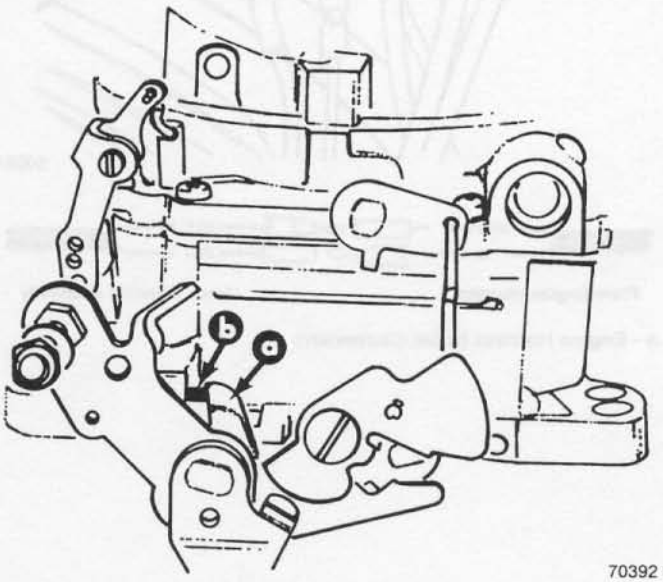
MODELS WITH WEBER 4 BARREL CARBURETOR



71159

a - Throttle Shaft Lever (Contacts "b" at W.O.T. Position)
b - Carburetor Body Casting

Wide-Open-Throttle Position Shown



70392

a - Throttle Lever (Contacts "b" in Idle Position)
b - Idle Speed Adjustment Screw

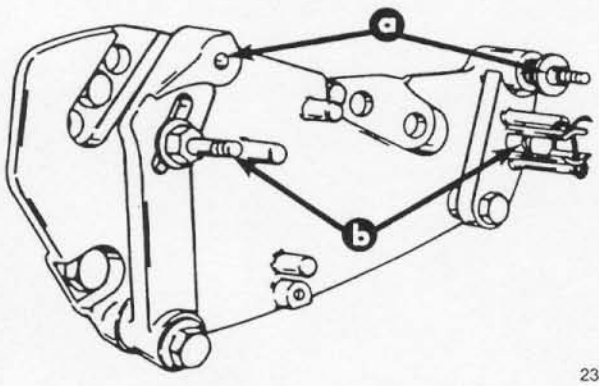
Idle Position Shown

IMPORTANT: Do not attach any accessory ground (-) wires to transom plate ground point. Accessory ground wires should only be attached to ground stud on engine.

7. Connect any grounding wires or accessories that may have been disconnected.

IMPORTANT: Adjust shift cables as outlined in appropriate "Stern Drive Service Manual."

8. Refer to appropriate "Stern Drive Service Manual" and install and adjust drive unit and remote control shift cables, using hardware retained.



23345

a - Remote Control Shift Cable Anchor Points
b - Drive Unit Shift Cable Anchor Points

IMPORTANT: After fluid hose installation in the following, bleed power steering system as outlined in appropriate "Stern Drive Service Manual."

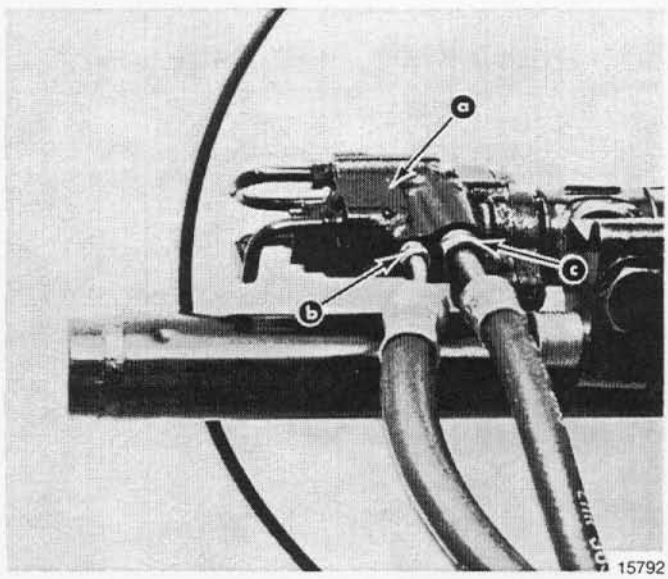
9. Connect power steering fluid hoses to control valve (large fitting first) as shown. Torque large fitting to 20-25 lb. ft. (27-34 N·m) and small fitting to 96-108 lb. in. (11-12 N·m).

⚠CAUTION

Route hoses exactly as shown below. This will help avoid stress on the hose fittings and will help avoid kinks in the hose.

IMPORTANT: Make hydraulic connections as quickly as possible to prevent fluid leakage.

IMPORTANT: Be careful not to cross-thread or overtighten fittings.



15792

a - Control Valve
b - Small Fitting
c - Large Fitting
Torque to Specifications

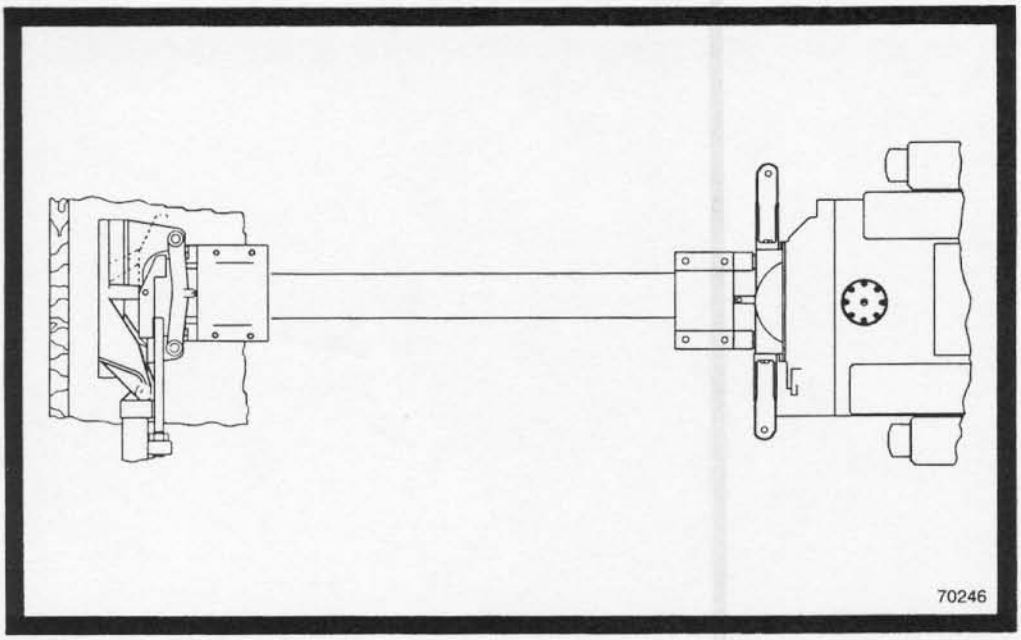
10. Connect battery cables to battery by FIRST connecting positive (+) battery cable (usually red) to positive (+) battery terminal. Tighten clamp securely. Then, connect negative (-) battery cable (usually black) to negative (-) battery terminal. Tighten clamp securely.

NOTE: Spray terminals with a battery connection sealant to help retard corrosion.

REMOVAL and INSTALLATION

2

D



MCM MODELS - BRAVO DRIVES with DRIVESHAFT EXTENSION

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Engine Mount Adjustment Was Not Disturbed During Service	2D-3
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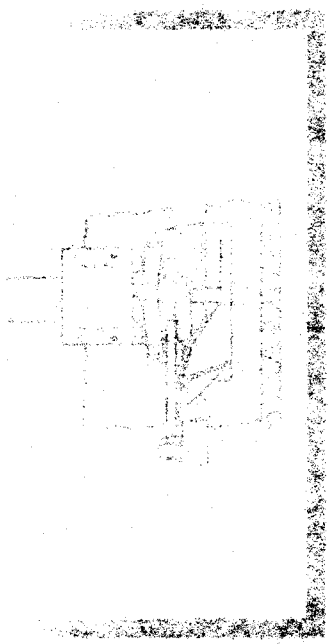
NOTICE

For service information on Drive Shaft and Bearing Support Assembly (Tailstock) refer to SECTION 8E - Drive Shaft Models/Propeller Shaft.



Torque Specifications

Fastener Location	Lb. Ft. (N·m)	Lb. In. (N·m)
Battery Cables	Securely	
Bearing Support (Tailstock) to Inner Transom Plate	35-40 (47-54)	
Drive Shift	50 (68)	
Drive Shaft Shield	30 (41)	
Extension Housing to Flywheel Housing	30 (41)	
Flywheel Housing	30 (41)	
Front and Rear Engine Mounts	Securely	
Hose Clamps	Securely	
Rear Engine Mount Bracket	50 (68)	
Power Steering Fluid Hose Fittings		
Large	20-25 (27-34)	
Small		96-108 (11-12)
Remote Control Throttle Cable		
Brass Barrel	Securely	
Cable End Guide	(Note 1)	

NOTE: Tighten, then back nut off 1 full turn.

Tools/Lubricants/Adhesives/Sealants

Part Number	Description
91-57797A3	Engine Alignment Tool
91-816391A4	Engine Coupler Spline Grease
92-25711--1	Liquid Neoprene
Obtain Locally	Loctite 271

Removal

IMPORTANT: It is not necessary to remove the engine to service the drive shaft and/or bearing support (tailstock). Refer to instructions as outlined in Section 8E - "Drive Shaft Repair" or "Bearing Support Assembly (Tailstock) Repair" for servicing these items only.

IMPORTANT: Stern drive unit does not have to be removed prior to engine removal. If stern drive is going to be removed, refer to appropriate "Stern Drive Service Manual."

Engine

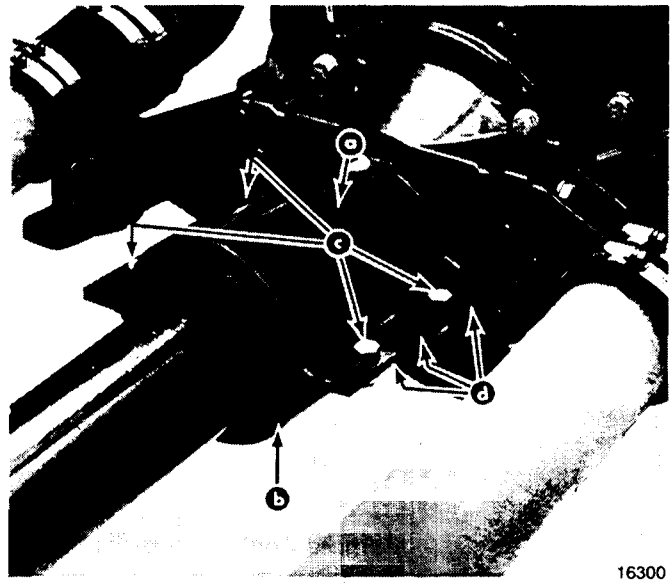
1. Disconnect battery cables from battery.
2. Remove instrument harness connector plug from engine harness receptacle after loosening clamp.

Be careful when working on fuel system. Gasoline is extremely flammable and highly explosive under certain conditions. Do not smoke or allow spark or open flame in area. Wipe up any spilled fuel immediately.

3. Disconnect and suitably plug fuel line, to prevent fuel in tank from leaking into bilge.
4. Disconnect throttle cable from carburetor and retain locknuts and hardware.
5. Disconnect trim position sender wires (coming from transom assembly) following instructions appropriate to your installation:
   a. Disconnect bullet connectors of trim sender wires from engine harness.
   b. Remove screw and nut on MerCathode controller assembly (if so equipped and on engine) and disconnect trim sender wire terminals.

NOTE: After wires are disconnected be sure to loosen them from clamps or sta-straps retaining them to engine or hoses.

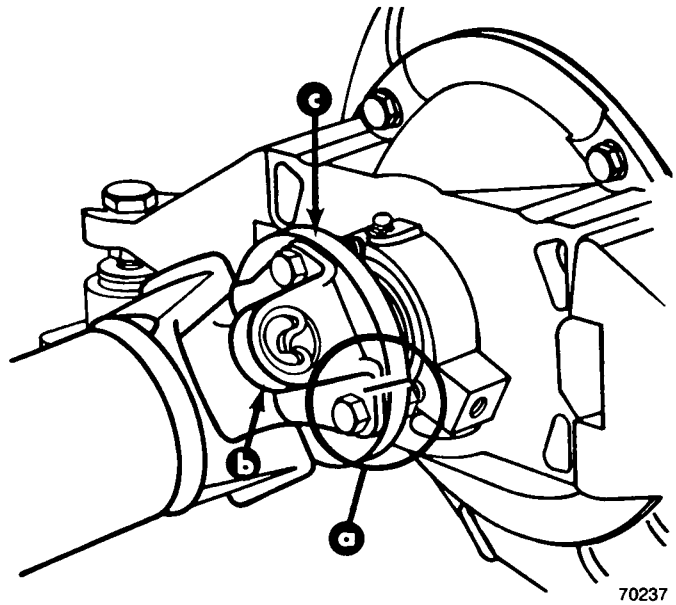
6. Disconnect MerCathode wires from MerCathode controller if mounted on engine (some models).
7. Disconnect seawater inlet hose from engine.
8. Disconnect exhaust pipes from exhaust hoses.
9. Disconnect any grounding wire or accessories that are connected to engine.
10. **Power Steering Models:** Disconnect (and suitably plug) fluid hoses from power steering control valve on transom.
11. Remove top and then bottom drive shaft shields at engine end of extension drive shaft.



16300

a - Top Shield
b - Bottom Shield
c - 4 Screws/Nuts (2 Hidden)
d - 3 Screws (Hidden)

12. Mark extension drive shaft U-joint yoke/output flange connections at engine end (to assist in exact same positioning during assembly). Disconnect drive shaft from output flange.



70237

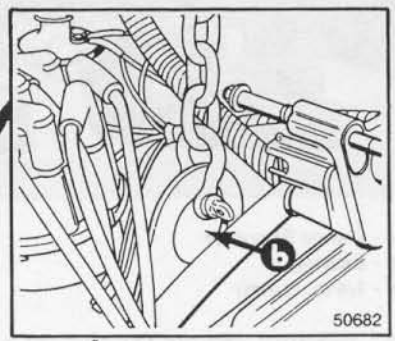
a - Matching Marks On Flange and Drive Shaft Connection
b - Extension Drive Shaft U-Joint Yoke
c - Flange, Output

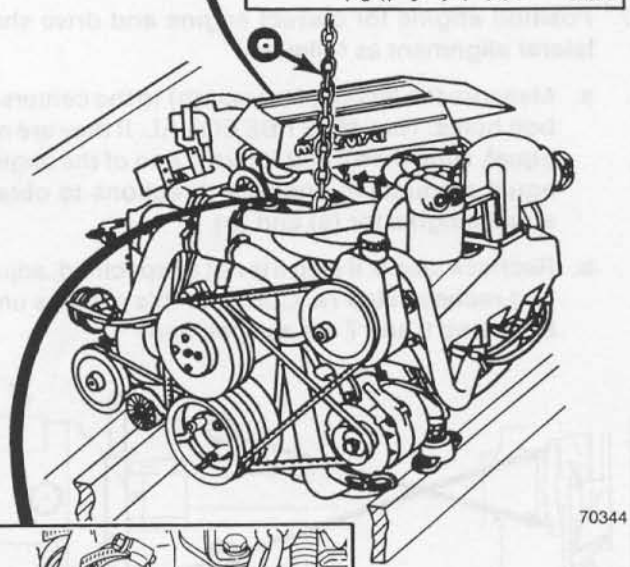
⚠CAUTION
Center lifting eye (located on top of thermostat housing) is used for engine alignment only. Do not use to lift entire engine.

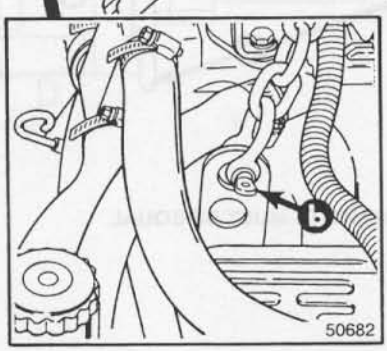
⚠CAUTION
Do not allow lifting sling to hook or compress engine components or damage will occur.

IMPORTANT: To avoid the need for a complete realignment (after engine repair), DO NOT MOVE FRONT AND REAR MOUNT ADJUSTMENT. Remove mounting bolts from boat stringers.

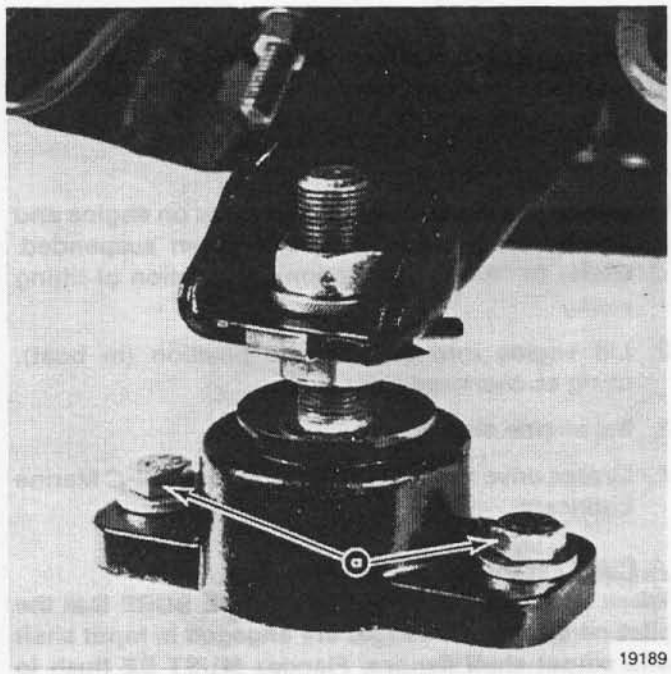
13. Support engine with suitable sling through lifting eyes on engine and remove front and rear engine mounting bolts from boat stringers. Retain hardware.







a - Suitable Sling
b - Engine Lifting Eyes



a - Mounting Bolts
Typical Mounting Shown

14. Carefully remove engine.

Installation

Engine Installation/Alignment

ENGINE MOUNT ADJUSTMENT WAS NOT DISTURBED DURING SERVICE

1. Attach a suitable sling to lifting eyes on engine and adjust so that engine is level when suspended. (Refer to "Removal" section for location of lifting eyes.)
2. Lift engine into approximate position (in boat), using an overhead hoist.
3. Set engine on stringers.
4. Grease drive shaft universal joints with 2-4-C Marine Lubricant.

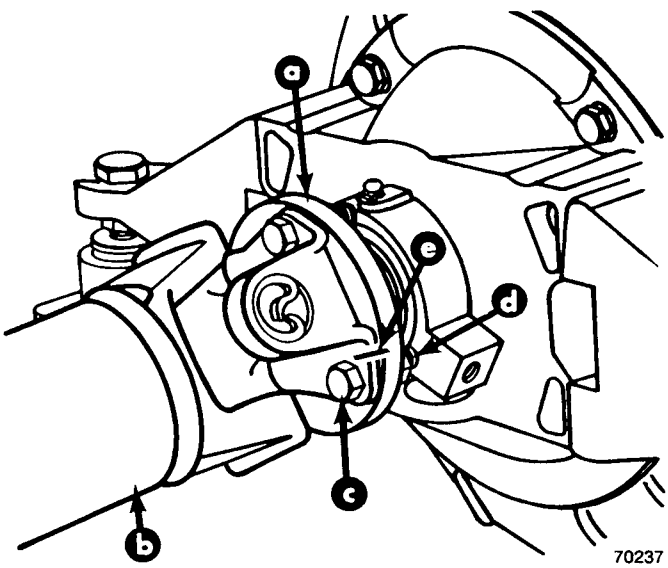
⚠CAUTION

When attaching shaft in next step, BE SURE that the pilot on drive shaft flanges are engaged in input shaft and output shaft flanges. Flanges MUST BE flush to each other prior to tightening screws or screws may come loose during operation.

⚠CAUTION

Failure to align shaft flanges with matching marks made on disassembly may cause improperly aligned drive unit and extension drive shaft U-joint centerlines resulting in a severe vibration problem.

5. As shown, attach engine output flange to drive shaft flange exactly as marked upon disassembly. Torque fasteners to 50 lb. ft. (68 N·m).

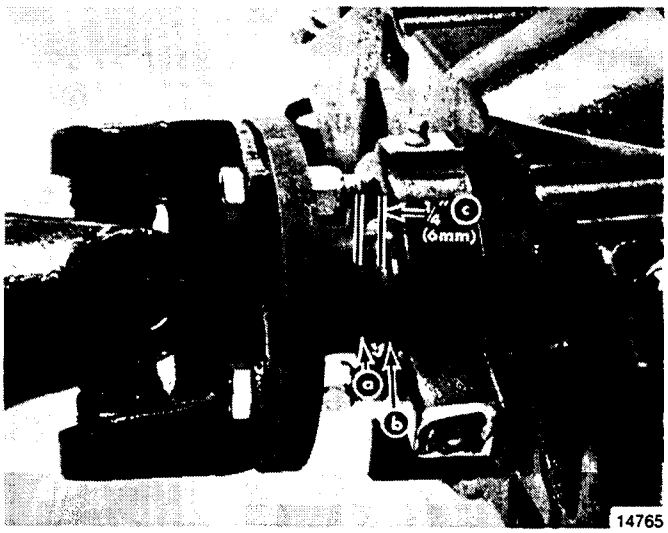


70237

a - Output Shaft Flange
b - Drive Shaft
c - Screw 7/16 in. - 20 x 1-1/2 in. (38mm) Long (4 Used) [Torque to 50 lb. ft. (68 N·m)]
d - Nut 7/16 in. - 20 (4 Used)
e - Matching Marks Made Upon Disassembly - Aligned

IMPORTANT: Failure to properly position output shaft flange may result in bearing damage.

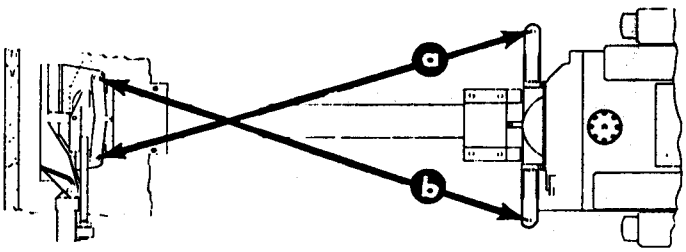
6. Relieve hoist tension from engine; then slide engine fore or aft as needed to obtain 1/4 in. (6mm) clearance between flange shoulder and extension shaft housing bearing.



14765

a - Flange Shoulder
b - Bearing
c - 1/4 in. (6mm)

7. Position engine for correct engine and drive shaft lateral alignment as follows:
   a. Measure the length of (a) and (b) to the centers of bolt holes. They MUST BE EQUAL. If they are not equal, slide the aft and forward end of the engine equal amounts in opposite directions to obtain equal lengths for (a) and (b).
   b. Recheck step 6. If step 6 is not as specified, adjust and recheck step 7a. Continue this process until both step 6 and 7 are as specified.

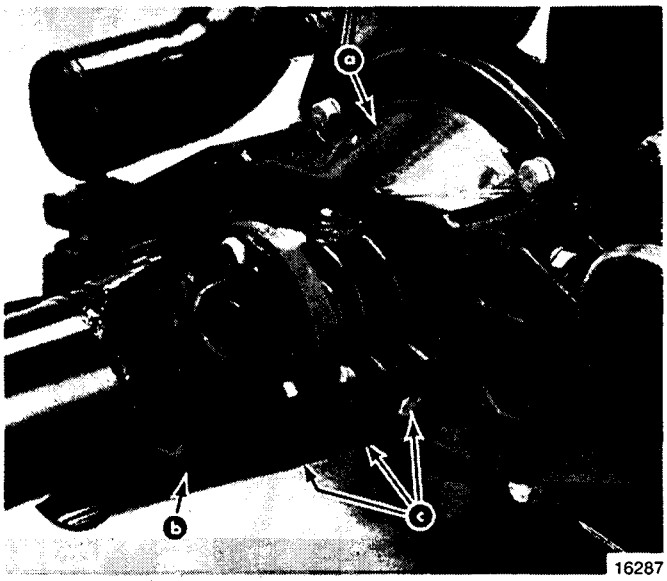


70246

THESE MEASUREMENTS **MUST BE EQUAL**

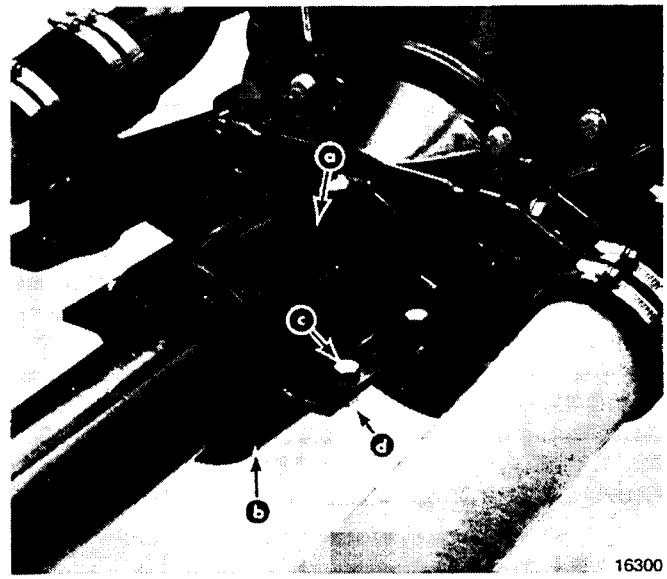
8. After engine has been aligned correctly, fasten front and rear engine mounts to stringers. Tighten mounting bolts securely.

9. Apply Loctite 271 to threads of bottom drive shaft shield retaining screws and install bottom shield on engine end as shown. Torque screws to 30 lb. ft. (41 N·m). Then install top shield as shown. Torque screws and nuts to 30 lb. ft. (41 N·m).



a - Shaft Housing
b - Bottom Shield
c - Screws [3 Used - Two Hidden In This View (Use Loctite 271)]

Engine End Shown



a - Top Shield
b - Bottom Shield
c - Screw (4 Used)
d - Nut (4 Used)

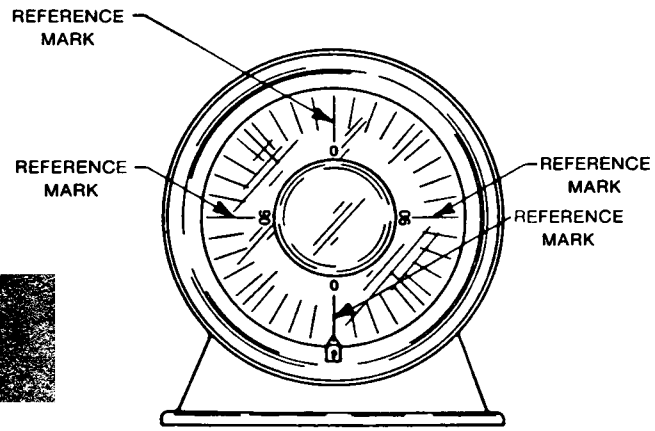
Engine End Shown

10. Proceed to "Engine Connections" section instructions following.

ENGINE MOUNT ADJUSTMENT WAS DISTURBED DURING SERVICE

NOTE: A Sears Craftsman Universal Protractor (stock number 9GT 3984) or equivalent is recommended for measuring the angles in the following steps.

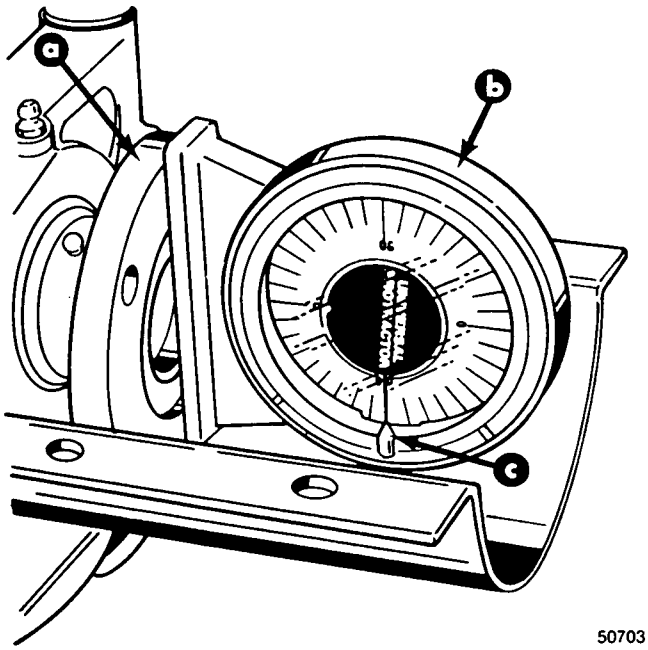
IMPORTANT: In the following steps, the protractor readings will be taken off of vertical and horizontal surfaces; therefore, both the 0° and the 90° marks will be used. It should be kept in mind that these are reference marks only and the assigned numbers should be ignored. It is only necessary to determine the number of degrees and to which side (left or right) of the reference marks the indicator needle rests. PROTRACTOR MUST BE VIEWED FROM THE SAME SIDE OF POWER PACKAGE THROUGHOUT INSTALLATION.



1. Refer to SECTION 8E - Drive Shaft Models/Propeller Shaft, and remove drive shaft.
2. Position base of protractor against input shaft flange, as shown. NOTE and RECORD the number of degrees and to which side of the reference mark the indicator needle has moved in the following chart.

Reading from Step 1. _____ degrees to the _____ side of Reference mark.

IMPORTANT: Be sure that boat does not move once reading has been taken from input shaft flange, as this reading establishes a reference point for aligning drive shaft and engine following. If boat is moved, reference point may be altered and subsequently, improper drive shaft and engine alignment may occur. Alignment tool MUST BE in place during entire alignment procedure, if drive unit is not installed.



50703

a - Input Shaft Flange
b - Protractor
c - Indicator Needle

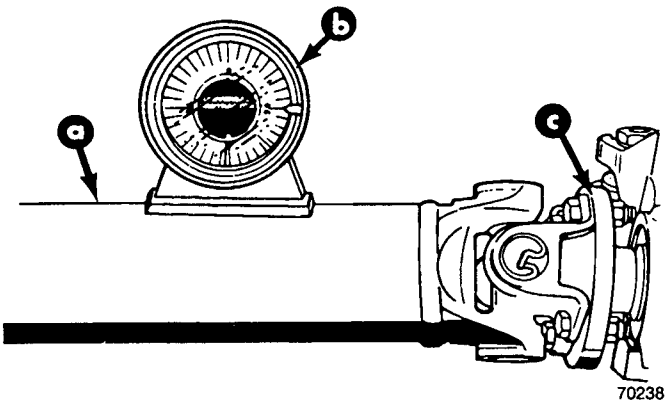
NOTE: For ease of installation we recommend the use of a chain leveler in the following steps.

3. Adjust engine mounts so that an equal amount of up and down adjustment exists.
4. Attach a suitable lifting chain to lifting eyes on engine and adjust so that engine will be level when suspended; then place engine into its approximate position (in boat) using an overhead hoist.
5. Refer to SECTION 8E - Drive Shaft Models/Propeller Shaft, and install drive shaft while observing precautions in SECTION 8E, especially about aligning gimbal bearing U-joint centerlines with extension drive shaft U-joint centerlines at bearing support input shaft. DO NOT install shields at this time.

⚠CAUTION

Engine MUST BE aligned correctly to achieve proper engine operation and to prevent damage to drive shaft. If drive shaft is run at an incorrect angle, damage to universal joint bearings may result.

6. Position base of protractor on drive shaft; then raise or lower engine (as boat construction permits) until indicator needle is 1° to 3° on either side of reading taken in Step 1. Record this reading in the following chart for later use.



70238

a - Drive Shaft
b - Protractor
c - Output Shaft Flange

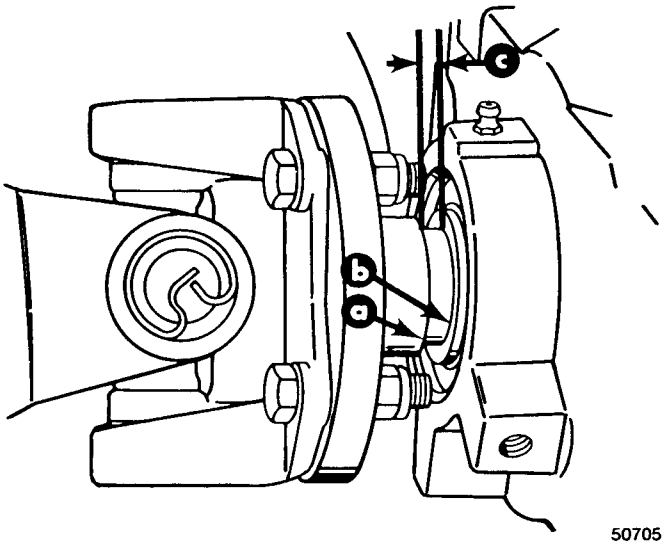
Reading from Step 6. _____ degrees to the _____ side of Reference mark.

7. Adjust stringer height so that the stringers just contact the engine mount bases.

⚠CAUTION

Failure to properly position output shaft flange (as described following) may result in bearing damage.

8. Relieve hoist tension from engine, then slide engine fore or aft as needed to obtain 1/4 in. (6.4mm) between flange shoulder and extension shaft housing bearing, as shown.



50705

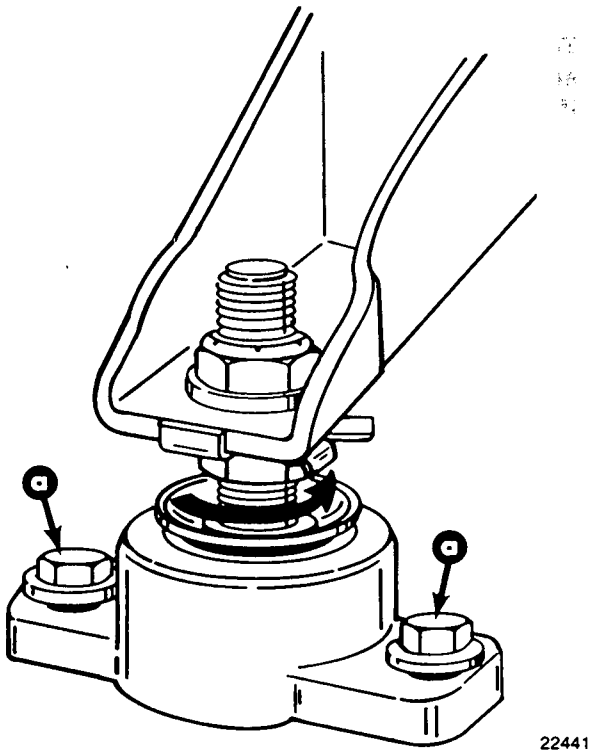
a - Flange Shoulder
b - Bearing
c - 1/4 in. (6mm)

9. Position engine for correct engine and drive shaft lateral alignment as follows:

   a. Measure the length of (a) and (b) to the centers of bolt holes. They MUST BE EQUAL. If they are not equal, slide the aft and forward end of the engine equal amounts in opposite directions to obtain equal lengths for (a) and (b).

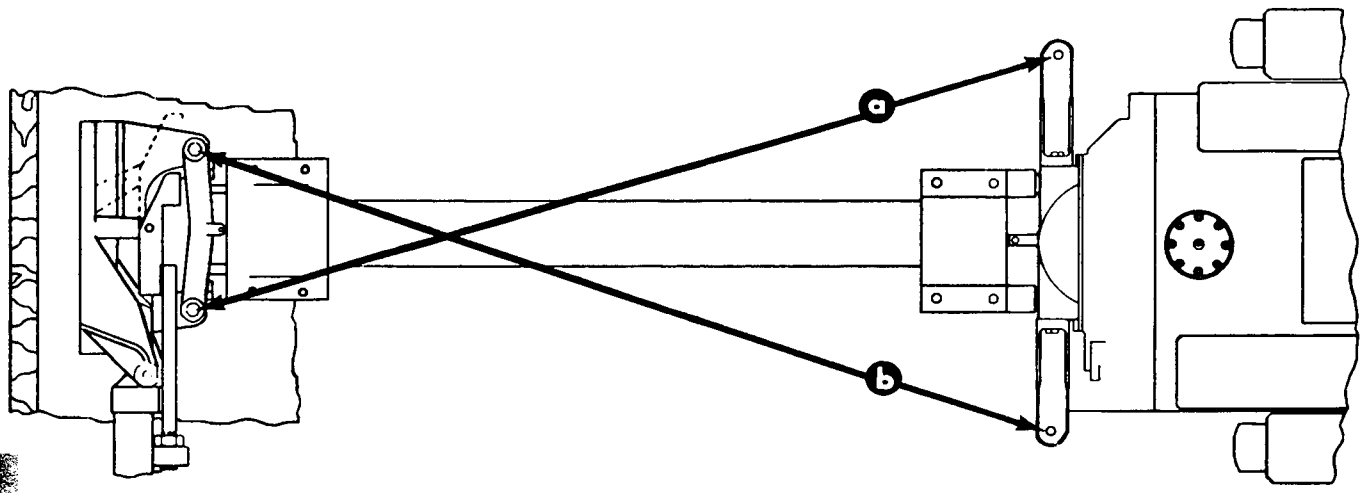
   b. Recheck step 8. If step 8 is not as specified, adjust and recheck step 9. Continue this process until both step 8 and 9 are as specified.

10. After engine has been aligned correctly, fasten front and rear engine mounts to stringers. Use 3/8 in. (9.5mm) diameter fasteners.



22441

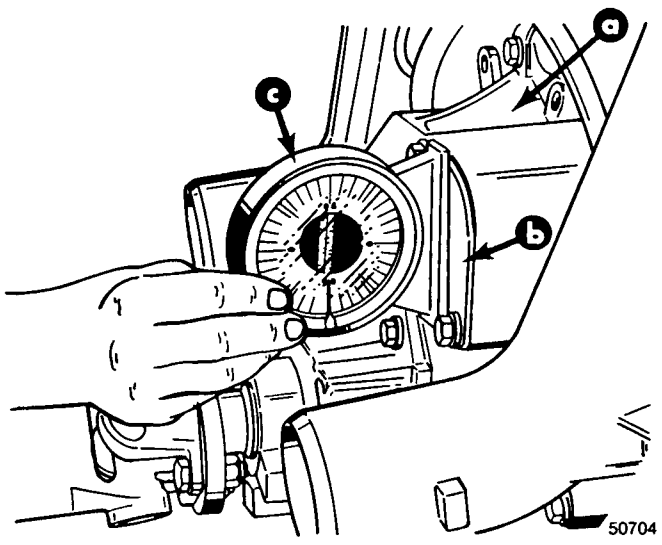
a - Screws



70246

THESE MEASUREMENTS **MUST BE EQUAL**

11. Position protractor on starter housing cover plate, as shown. Now, raise or lower front engine mount adjusting nuts as required so that protractor needle reads exactly the same number of degrees as that recorded in Step 1.

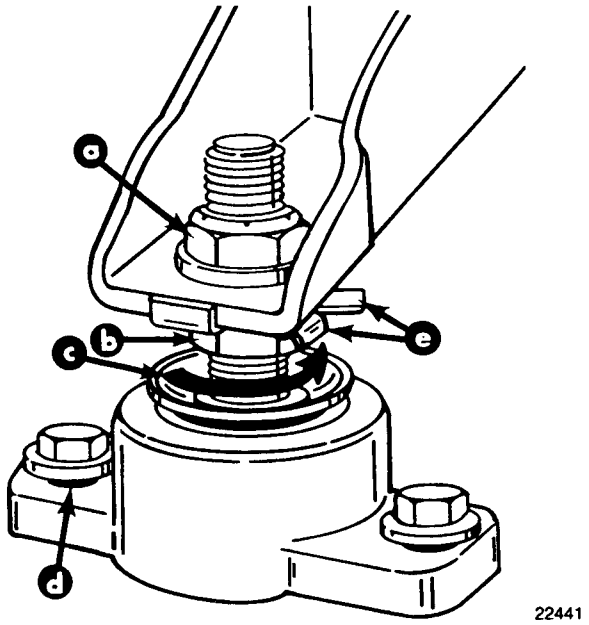


a - Flywheel Housing
b - Starter Housing Cover Plate
c - Protractor

Thru-Prop Exhaust Shown

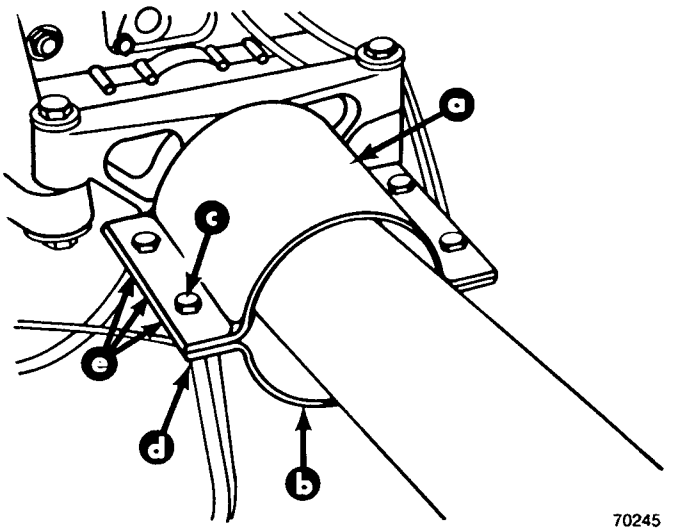
12. Position protractor on drive shaft and recheck angle. Angle should be the same as that recorded in Step 6. If not, raise or lower all 4 engine mount adjusting nuts an equal amount until correct angle is reached.

13. Tighten ALL engine mount nuts securely. Bend tab washer down on adjusting nut.



a - Nut and Lockwasher
b - Adjustment Nut
c - Turn Adjustment Nut in this Direction (Counterclockwise) to Raise Front of Engine
d - Slotted Hose Toward Front of Engine
e - Tab Washer

14. Apply Loctite 271 to threads of bottom drive shaft shield retaining screws and install bottom shields on engine and transom end as shown. Torque screws to 30 lb. ft. (41 N·m). Then install both top shields as shown. Torque screws and nuts to 30 lb. ft. (41 N·m).



a - Top Shield
b - Bottom Shield
c - Bolt [3/8 in. - 16 x 7/8 in. (22.2mm); 4 Used]
d - Nut (3/8 in. - 16; 4 Used)
e - Screws [3 Used - Hidden In This View (Use Loctite 271)]

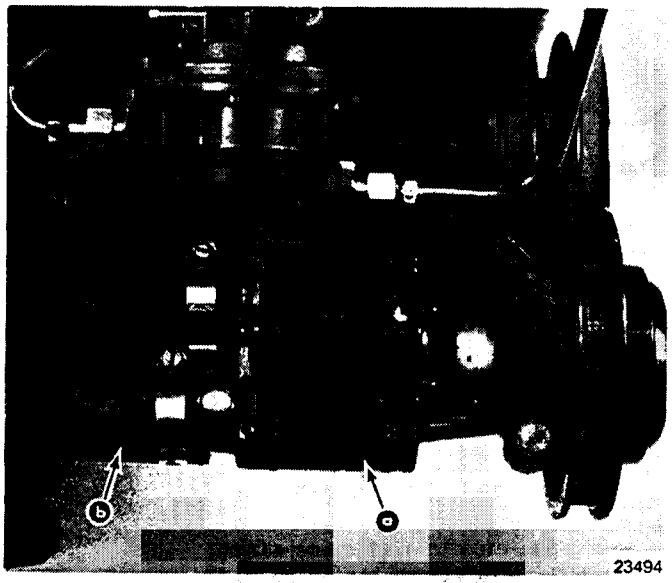
Top Shield and Bottom Shield At Transom End (Engine End Similar)

15. Proceed to "Engine Connections" section instructions following.

Engine Connections

IMPORTANT: When routing all wire harnesses and hoses, be sure they are routed and secured to avoid coming in contact with hot spots on engine and avoid contact with moving parts.

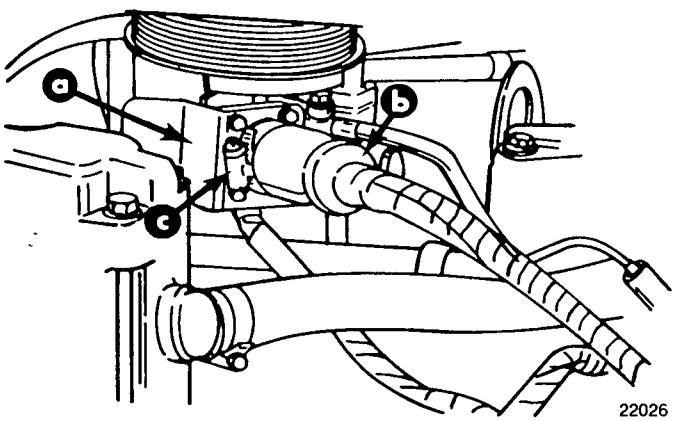
1. Connect seawater inlet hose to seawater pump. Tighten hose clamp securely.



a - Seawater Pump
b - Seawater Inlet Hose (Hose Connects to Top Fitting on Some Pumps - Not Shown Here)

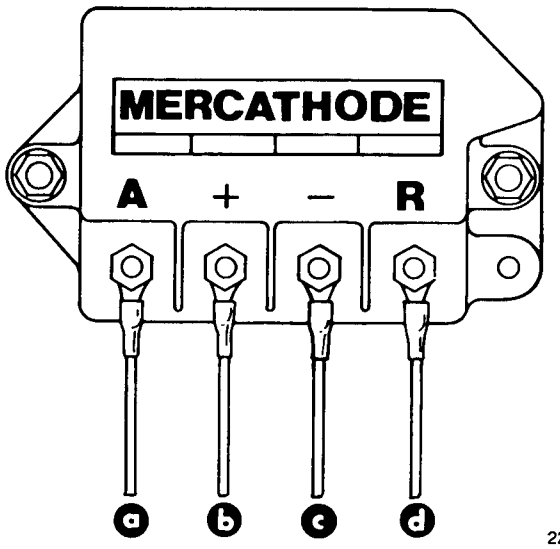
NOTE: Generation V, GM Big Blocks with seawater pump/fuel pump assembly have seawater hose connection on top fitting.

2. Connect instrument harness to engine harness with hose clamp. Tighten clamp securely.



a - Engine Wiring Harness Receptacle Bracket
b - Instrumentation Wiring Harness Plug
c - Hose Clamp - Tighten Securely

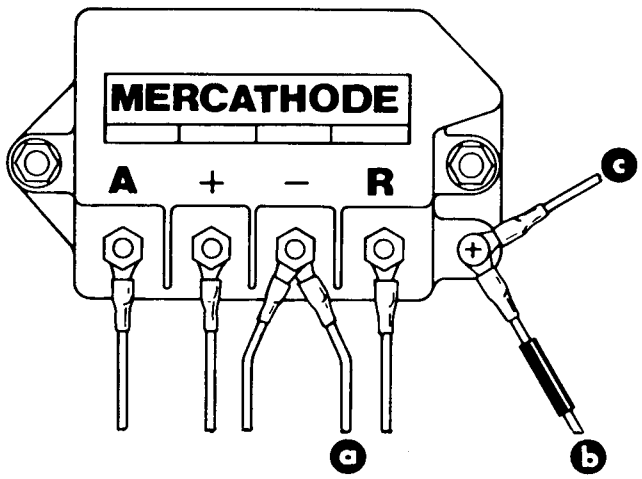
3. **Models With MerCathode:** Connect wires to MerCathode controller assembly as shown. Apply a thin coat of Liquid Neoprene to all connections.



a - Orange Lead - From Electrode on Transom Assembly
b - Red/Purple Lead - Connect (Other End) to Positive (+) Battery Terminal
c - Black Lead - From Engine Harness
d - Brown Lead - From Electrode on Transom Assembly

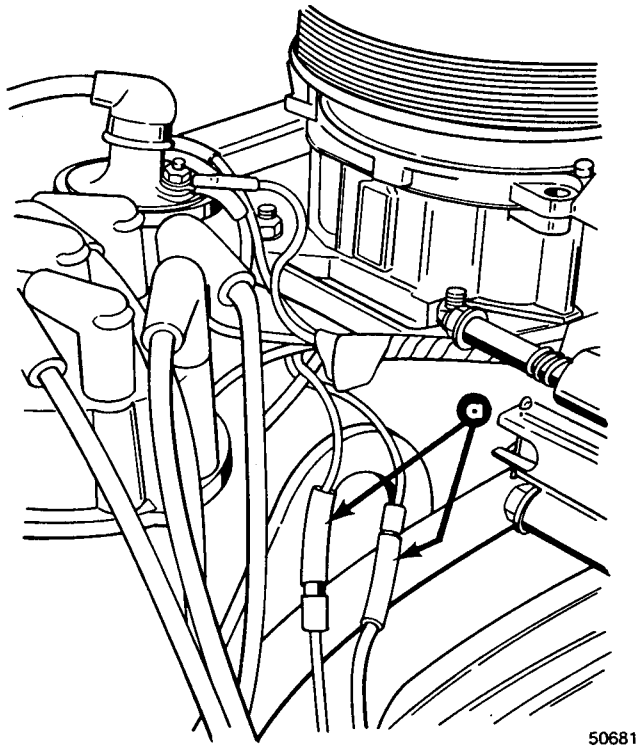
4. Connect trim position sender wires following instructions "a" or "b":

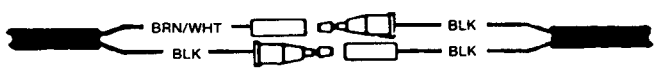
   a. **On some engines with engine harness/trim sender wires mounted on MerCathode controller:** Connect wires as shown. Apply a thin coat of Liquid Neoprene to all connections.



a - Trim Position Sender Lead **Without** Sleeve
b - Trim Sender Lead With Brown or Purple Sleeve
c - Brown/White Lead - From Engine Harness

b. **On later engines with engine harness/trim sender wires with bullet connectors:** Connect sender wires to engine harness as shown.





From Engine Harness From Transom Assembly

a - Engine Harness Bullet Connectors

⚠WARNING

Be careful when working on fuel system. Gasoline is extremely flammable and highly explosive under certain conditions. Do not smoke or allow spark or open flame in area. Wipe up any spilled fuel immediately.

5. Connect fuel line (from fuel tank) to engine. Make certain connection is secure. Check for leaks.

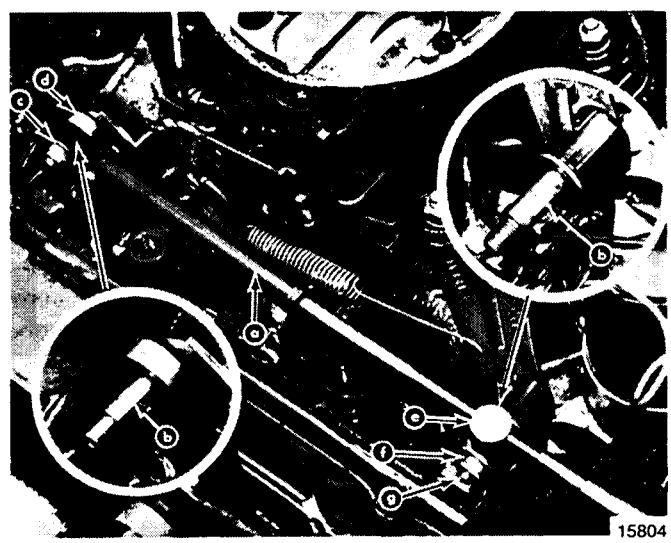
6. Install and adjust throttle cable(s) using hardware as follows:

   a. Place remote control handle(s) in neutral, idle position.

IMPORTANT: Be sure that cable is routed in such a way as to avoid sharp bends and/or contact with moving parts. DO NOT fasten any items to throttle cable. Outer cable must be free to move when cable is actuated.

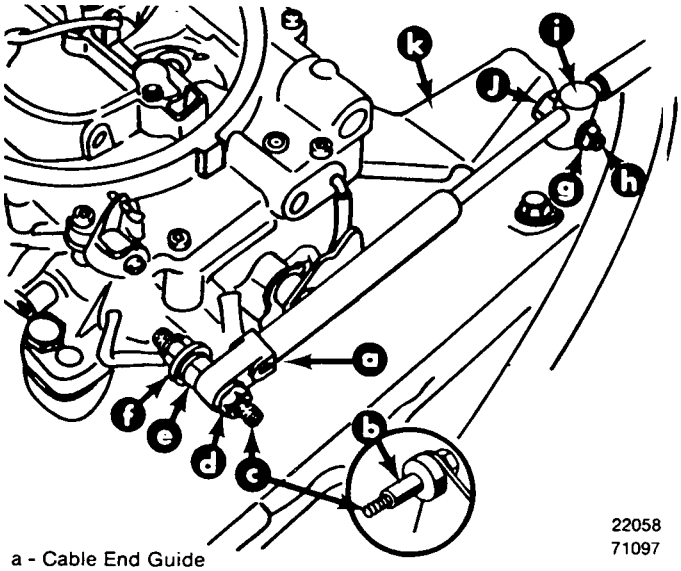
   b. Install cable end guide on throttle lever, then push cable barrel lightly toward throttle lever end. (This will place a slight preload on cable to avoid slack in cable when moving remote control lever.) Adjust barrel on throttle cable to align with anchor stud.

   c. Secure throttle cable with hardware (retained) as shown. Tighten cable end guide nut until it bottoms out and then back off 1 full turn. Tighten barrel securely. DO NOT OVER-TIGHTEN, as cable must pivot freely.



a - Cable End Guide
b - Bushing
c - Washer, Nut and Throttle Lever Stud
d - Spacer
e - Barrel
f - Washer and Nut (DO NOT Over-Tighten)
g - Anchor Stud

Rochester Carburetor Shown



22058
71097

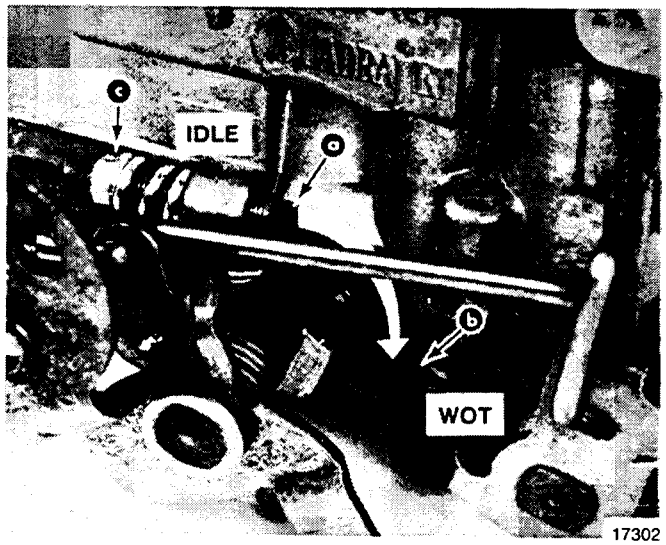
a - Cable End Guide
b - Bushing
c - Throttle Lever Stud
d - Locknut and Flat Washer - Tighten Until Nut Bottoms Out, Then Back Off 1 Full Turn
e - Spacer
f - Throttle Lever
g - Flat Washer and Locknut
h - Throttle Cable Anchor Stud
i - Cable Barrel
j - Flat Washer
k - Throttle Bracket

Weber Carburetor Shown

d. Place remote control throttle lever in the wide-open-throttle (W.O.T.) position. Check to ensure that throttle shutters (valves) are completely open.

e. Return remote control throttle lever to idle position and check to ensure that throttle lever contacts idle speed adjustment screw.

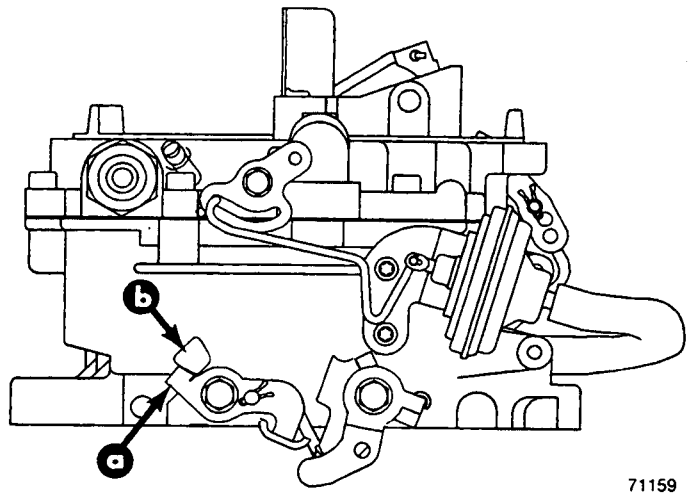
MODELS WITH ROCHESTER 4 BARREL CARBURETOR



17302

a - Tang
b - Carburetor Body
c - Idle RPM Adjustment Screw

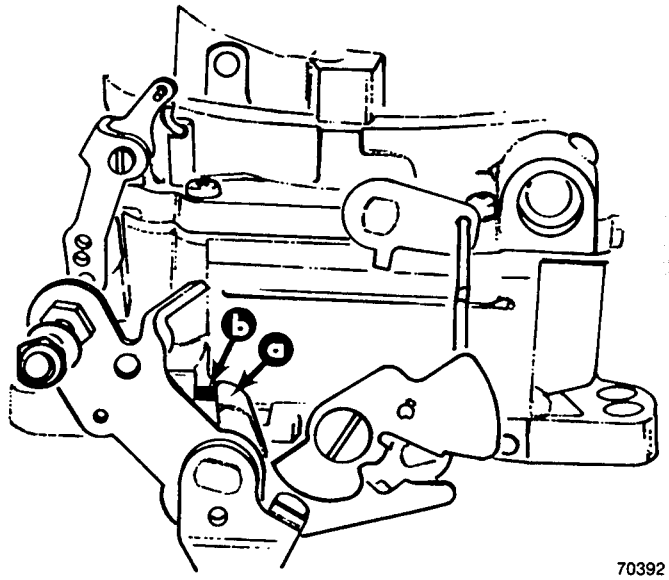
MODELS WITH WEBER 4 BARREL CARBURETOR



71159

a - Throttle Shaft Lever (Contacts "b" at W.O.T. Position)
b - Carburetor Body Casting

Wide-Open-Throttle Position Shown



70392

a - Throttle Lever (Contacts "b" in Idle Position)
b - Idle Speed Adjustment Screw

Idle Position Shown

IMPORTANT: Do not attach any accessory ground (-) wires to transom plate ground point. Accessory ground wires should only be attached to ground stud on engine.

7. Connect any grounding wires or accessories that may have been disconnected.

IMPORTANT: After fluid hose installation in the following, bleed power steering system as outlined in appropriate "Stern Drive Service Manual."

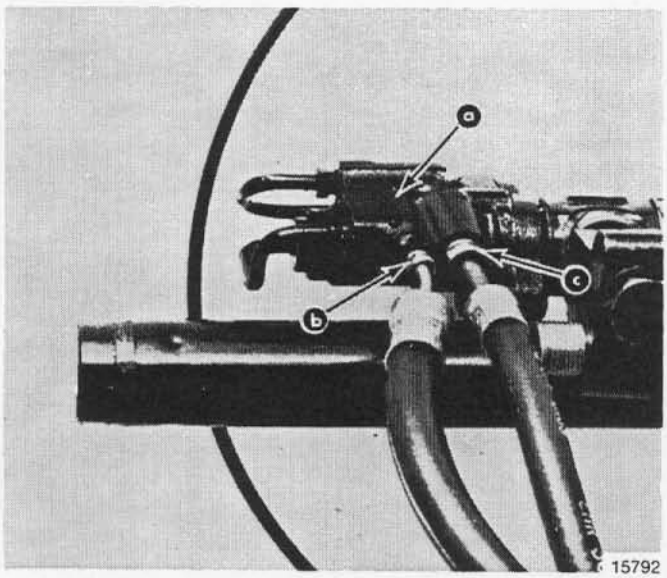
8. **Power Steering Models:** Connect power steering fluid hoses to control valve (large fitting first) as shown. Torque large fitting to 20-25 lb. ft. (27-34 N·m) and small fitting to 96-108 lb. in. (11-12 N·m).

⚠CAUTION

Route hoses exactly as shown below. This will help avoid stress on the hose fittings and will help avoid kinks in the hose.

IMPORTANT: Make hydraulic connections as quickly as possible to prevent fluid leakage.

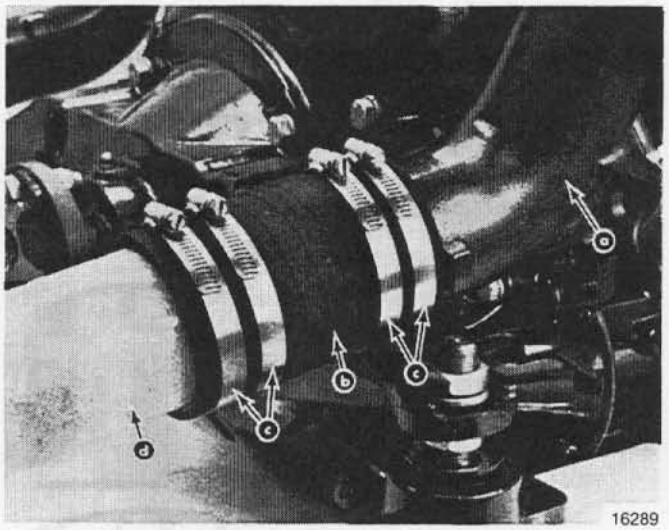
IMPORTANT: Be careful not to cross-thread or overtighten fittings.



a - Control Valve
b - Small Fitting
c - Large Fitting
Torque to Specifications

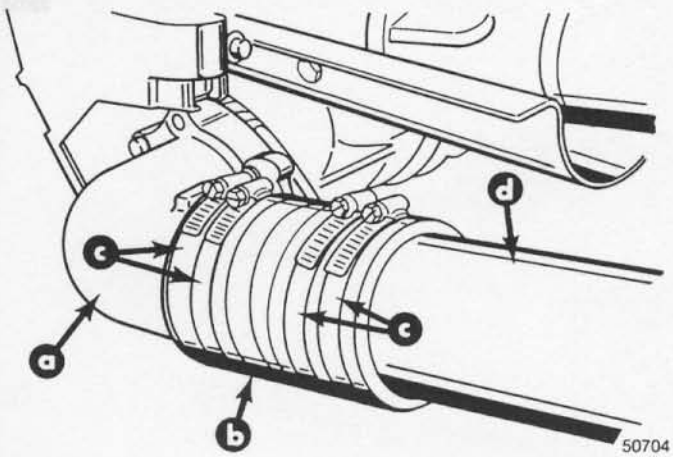
9. Install exhaust hoses and exhaust tubes and tighten all hose clamps securely as follows (use double hose clamps on all connections):

   a. **On Engines With Thru-Prop Exhaust:**



a - Exhaust Pipe
b - Exhaust Hose
c - Hose Clamps
d - Exhaust Tube

Starboard Side Engine End Shown (Port Similar)



a - Exhaust Separator Assembly
b - Exhaust Hose
c - Hose Clamps
d - Exhaust Tube

Starboard Side Transom End Shown (Port Similar)

b. **On Engines With Thru-Transom Exhaust:**

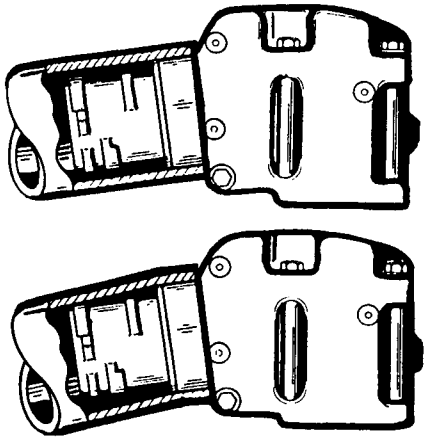
NOTICE (THRU-TRANSOM EXHAUST)

Exhaust hoses must be connected to exhaust elbows so that they do not restrict the flow of discharge water from exhaust elbow. If hoses are connected incorrectly, discharge water from exhaust elbow will not flow around entire inside diameter of hose. This will cause a hot spot in the hose which may eventually burn thru.

NOTE: Hose clamps not shown for visual clarity in the following.

CORRECT

INCORRECT



22032

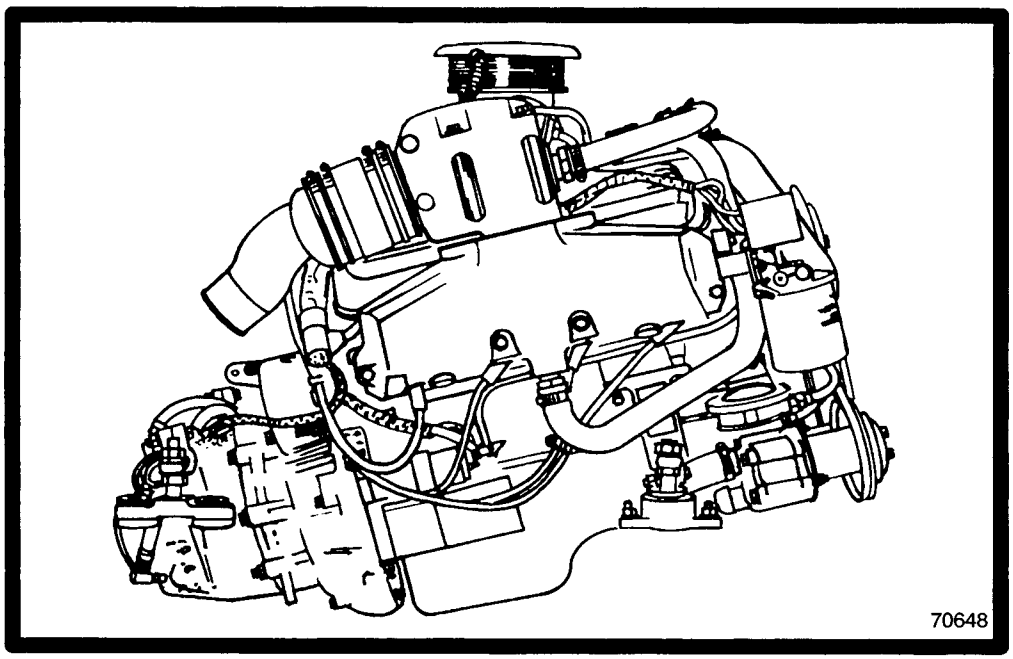
10. Connect battery cables to battery by FIRST connecting positive (+) battery cable (usually red) to positive (+) battery terminal. Tighten clamp securely. Then, connect negative (-) battery cable (usually black) to negative (-) battery terminal. Tighten clamp securely.

NOTE: Spray terminals with a battery connection sealant to help retard corrosion.

REMOVAL AND INSTALLATION

2

E



MIE MODELS WITH BORG-WARNER TRANSMISSION

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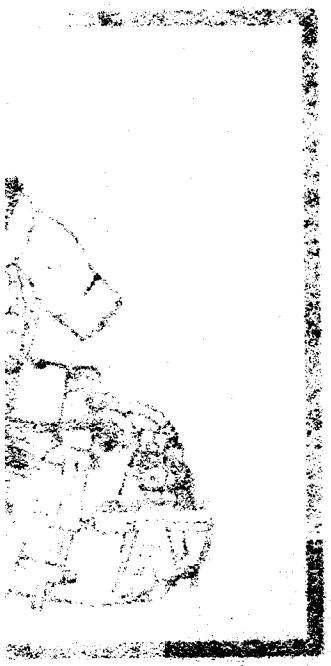


TORQUE SPECIFICATIONS

FASTENER LOCATION		LBS. FT. (N·m)
Battery Cables		Securely
Engine Mount Pads		Securely
Hose Clamps		Securely
Mount Locking Nut		Securely Note 2
Propeller Shaft Coupler-to-Transmission Output Flange		50 (68)
Remote Control Shift Cable	Brass Barrel	Securely
	Cable End Guide	Note 1
Remote Control Throttle Cable	Brass Barrel	Securely
	Cable End Guide	Note 1
Trunnion Clamping Screw/Nut		50 (68)

Note 1: Tighten, then back nut off 1 full turn.

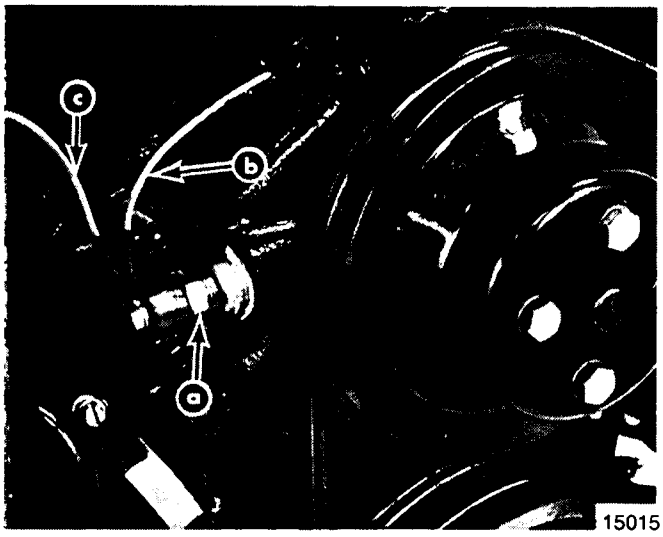
Note 2: Bend tab against adjusting nut.

LUBRICANTS/SEALERS

LUBRICANTS	
92-86154A1	Quicksilver 2-4-C Marine Lubricant
92-25711	Quicksilver Liquid Neoprene

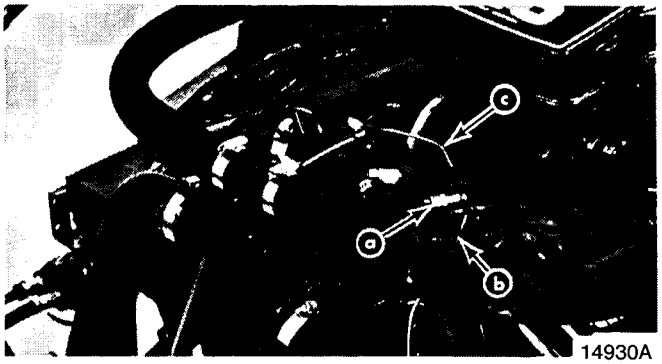
Removal

1. Disconnect battery cables from battery.
2. Remove instrument panel harness connector plug from engine harness receptacle.
3. Disconnect fuel line (from fuel tank) from engine.
4. Disconnect throttle cable from carburetor.
5. Disconnect shift cable from transmission.
6. Disconnect seawater inlet hose from engine.
7. Disconnect exhaust system hoses.
8. Disconnect any ground wires or accessories that are connected to engine.
9. If not part of main engine wiring harness, disconnect audio warning system Tan/Blue wire (from buzzer) at engine heat switch as shown.



a - Water Heat Switch
b - Tan/Blue Wire (Jumper Wire to Engine Oil Pressure Switch)
c - Disconnect Tan/Blue Wire (From Buzzer)

Early MIE 5.7L Model Engine Shown



a - Water Heat Switch
b - Tan/Blue Wire (Jumper Wire to Engine Oil Pressure Switch)
c - Disconnect Tan/Blue Wire (From Buzzer)

Early MIE 7.4L Model Engine Shown

10. Disconnect propeller shaft coupler from transmission output flange.

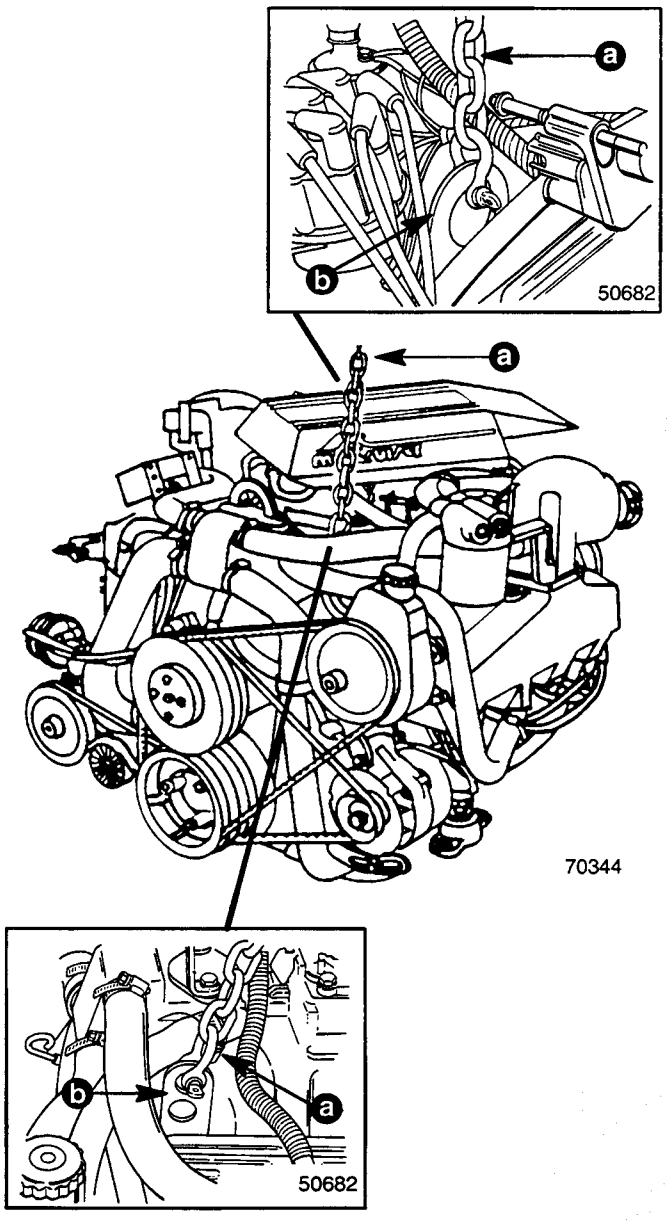
⚠CAUTION

Center lifting eye (located on top of thermostat housing) is used for engine alignment only. Do not use to lift entire engine.

⚠CAUTION

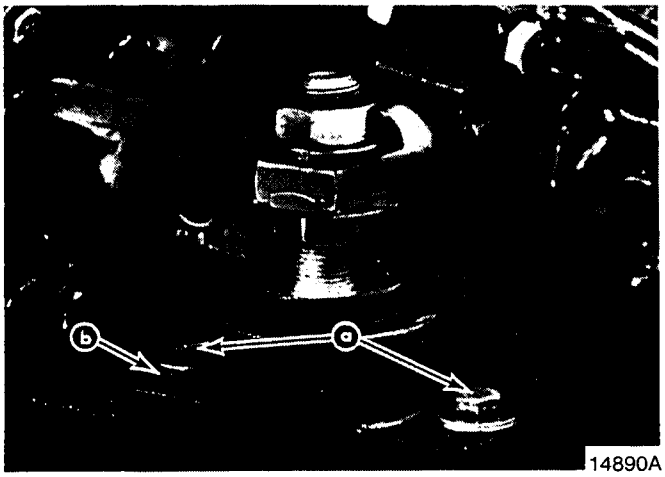
Do not allow lifting sling to hook or compress engine components or damage to them will occur.

11. Support engine with suitable sling thru lifting eyes on engine.



a - Suitable Sling
b - Engine Lifting Eyes

12. Remove front and rear engine mounting bolts. Retain hardware.



14890A

a - Bolts or Lag Screws (With Washers)
b -Slotted Hole - Forward

13. Carefully remove engine.

Installation

Engine Installation and Initial Alignment

1. Follow instructions "a" or "b":

   a. **Engine mount(s) or adjustment WAS NOT DISTURBED during engine service:** Proceed to following step 2.

   b. **Engine mount(s) or adjustment WAS DISTURBED during engine service:**

IMPORTANT: Engine mounts must be adjusted, as explained in the following, to center mount adjustment and establish a uniform height on all mounts.

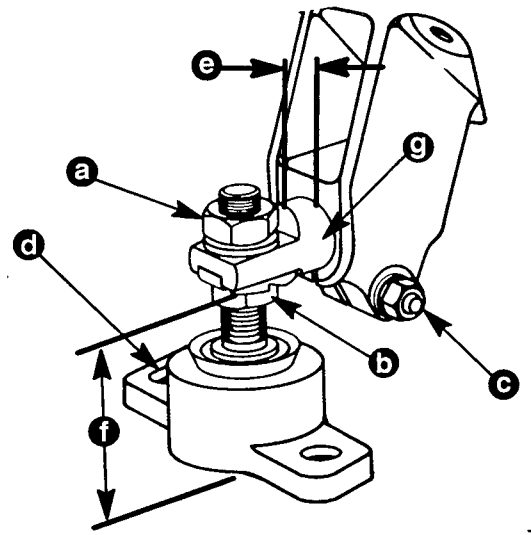
Ensure that all mounts are:

(1) In the center of their up-and-down adjustment.

(2) Mounting hole which is a slot is forward (if so designed, 350 Magnum Tournament Ski rear mount does not have a slotted hole).

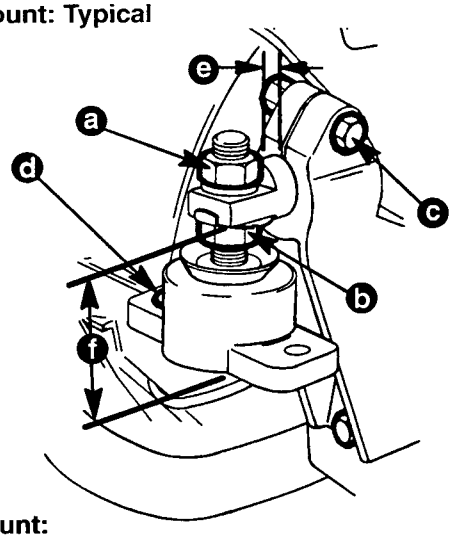
(3) Large diameter of mount trunnion extended as shown.

(4) Each mount base is downward. Tighten clamping screws and nuts slightly to prevent moving in or out. Mounts must be free to pivot when installing engine.



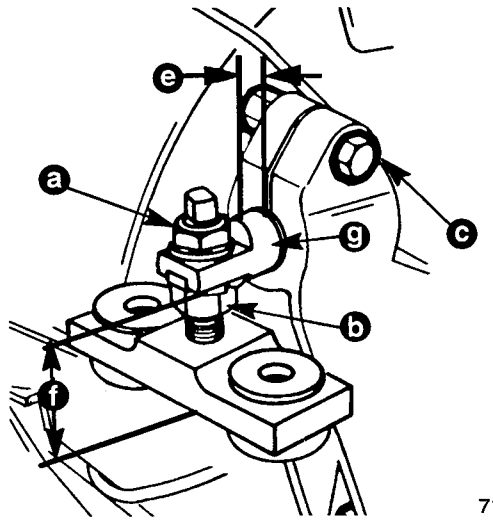
70140

Front Mount: Typical



22555

Rear Mount:



71182

Rear Mount: 350 Magnum Tournament Ski

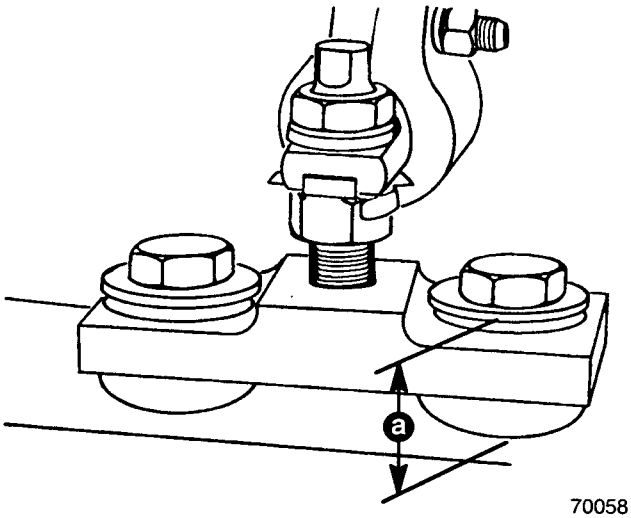
a - Locking Nut
b - Adjusting Nut
c - Trunnion Clamp Screw and Nut, With Lockwasher
d - Slot Forward
e - 3/8 in. ± 1/16 in. (10mm ± 2mm)
f - 2-5/8 in. ± 1/16 in. (67mm ± 2mm)
g - Mount Trunnion

2. Attach a suitable sling to lifting eyes on engine (refer to removal section for location of lifting eyes).
3. Lift engine into boat and position on engine bed so that transmission output flange and propeller shaft coupler are visibly aligned (no gap can bee seen between coupling faces when butted together). **Adjust engine bed height,** if necessary, to obtain proper alignment. DO NOT use mount adjustments to adjust engine position at this time.

IMPORTANT: Engine bed must position engine so that a minimum of 1/4 in. (6mm) up-and-down adjustment still exists on all 4 mounts after performing final alignment. This is necessary to allow for final engine alignment.

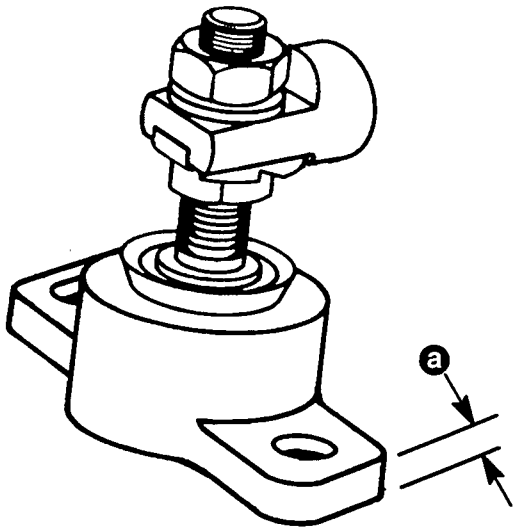
4. Check all four mounts to ensure that they are still positioned properly; then fasten mounts to engine bed with appropriate length bolts or lag screws and hardware. Tighten lag bolts/screws securely.

IMPORTANT: If equipped with new style rear mounts, longer lag screws should have been used. Be certain to install appropriate length lag screw or fastener on new style rear mounts.



a - 1-1/2 in. (39mm)

New Style Rear Mount (Longer Fasteners Required)



a - 1/2 in. (13mm)

Typical Rear Mount

5. Disconnect and remove sling. Proceed to "Engine Final Alignment" section following.

Engine Final Alignment

⚠CAUTION

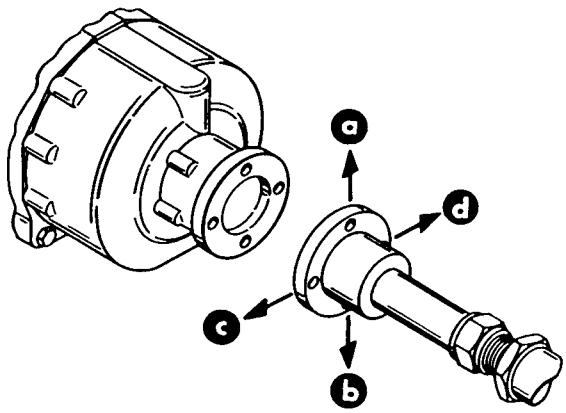
To avoid vibration, noise, and damage to transmission output shaft oil seal and bearings, engine must be properly aligned.

IMPORTANT: Engine alignment MUST BE RECHECKED with boat in the water, fuel tanks filled and with a normal load onboard.

Engine must be aligned so that transmission output flange and propeller shaft coupler centerlines are aligned and coupling faces are parallel within .003 in. (0.07mm). This applies to installations with solid couplings, as well as flexible couplings.

1. Check mating surfaces on transmission output flange and propeller shaft coupler faces to make sure they are clean and flat.

2. Center propeller shaft in shaft log as follows:
   a. Push down and then lift shaft as far as it will move. Then place shaft in the middle of the movement.
   b. Move shaft to port and then to starboard as far as shaft will move. Then place shaft in the middle of the movement.
   c. With shaft in center of shaft log, as determined by above procedures "a" and "b", align engine to shaft.

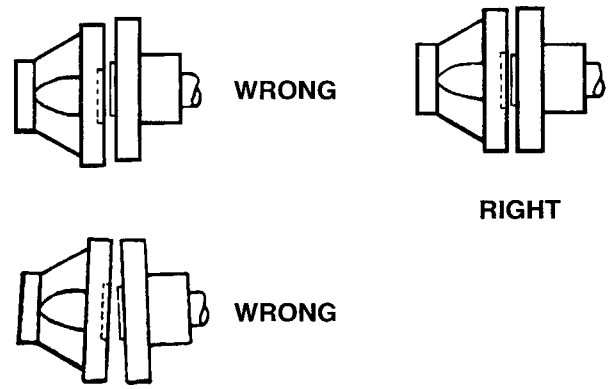


648-H

a - Up
b - Down
c - Port
d - Starboard

3. Check that coupling centerlines align, by butting propeller shaft coupler against transmission output flange. Shoulder on propeller shaft coupler should engage recess on transmission output flange face with no resistance.

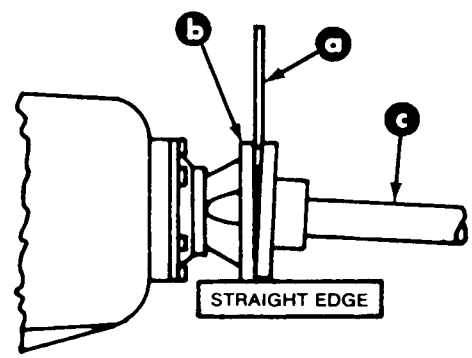
NOTE: Some propeller shaft couplers may not have a shoulder on mating face. On these installations, use a straight edge to check centerline alignment.



22457

IMPORTANT: Remote V-Drive Models: Refer to Remote V–Drive manufacturers instructions for drive shaft (between transmission and remote V-Drive) alignment.

4. Check for angular misalignment, by hand holding coupling faces tightly together and checking for a gap between faces with a .003 in. (0.07mm) feeler gauge at 90° intervals.

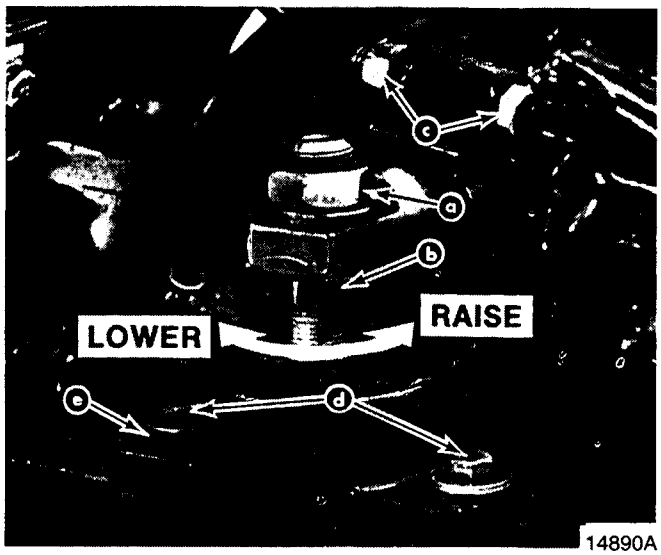


a - Feeler Gauge (Check at 90 Degree Intervals)
b - Transmission Output Flange
c - Propeller Shaft Coupler

5. If coupling centerlines are not aligned or if coupling faces are more than .003 in. (0.07mm) out-of-parallel, adjust engine mounts as follows:

   a. TO ADJUST ENGINE UP OR DOWN: Loosen locking nut on mounts requiring adjustment and turn both front mounts or rear mounts adjusting nuts equally.

IMPORTANT: Both front mounts (or rear mounts) adjusting nuts must be turned equally to keep engine level from side to side.



14890A

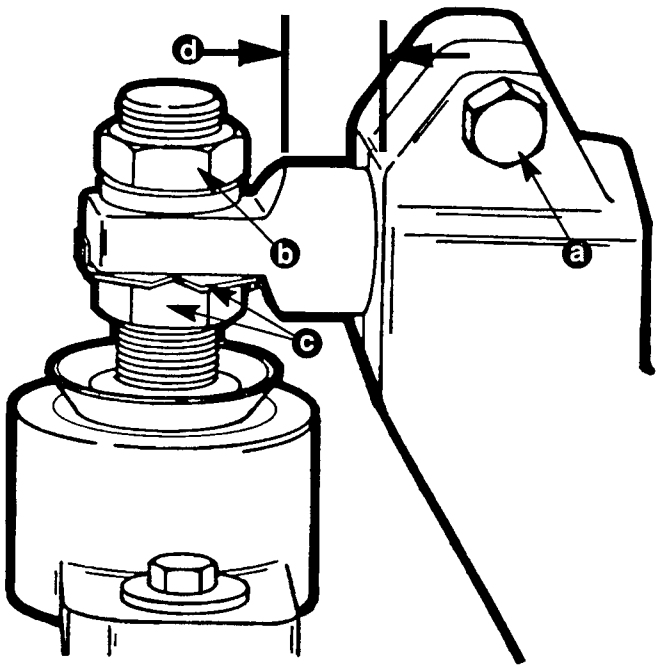
a - Locking Nut
b - Adjusting Nut
c - Clamping Screw and Nut
d - Lag Screws (or Bolts)
e - Slot Forward

Typical Mount Shown

   b. TO MOVE ENGINE TO THE LEFT OR RIGHT: Loosen clamping screw and nut on all 4 mount brackets and move engine to the left or right as necessary, to obtain proper alignment. On mounts which do have a slotted hole, a small amount of adjustment can be obtained with slot on front end of mounts. Loosen lag screws (which fasten mounts to engine bed) and move engine, as required. Tighten lag screws securely.

   c. After engine has been properly aligned: Tighten engine mount nuts securely, and be certain to bend one of the tabs on the tab washer down onto flat of mount adjusting nut. Torque clamping screws and nuts to 50 lb.ft. (68 N·m).

IMPORTANT: Large diameter of mount trunnion MUST NOT extend over 3/4 in. (20mm) from mount brackets on any of the mounts.



22554

a - Torque Clamping Screw and Nut on All 4 Mount Brackets to 50 lb.ft.(68 N·m)
b - Tighten Locking Nut On All 4 Mounts Securely
c - Bend One of the Tabs on Tab Washer Down onto Flat of Adjusting Nut
d - Maximum Extension of Large Diameter of Trunion - 3/4 in. (20mm)

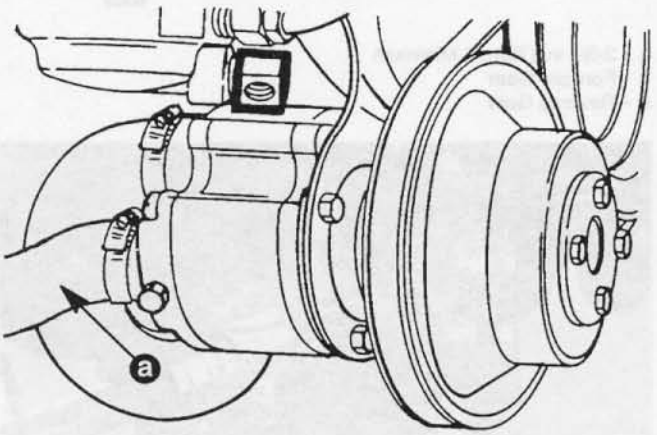
6. Connect propeller shaft coupler to transmission output flange. Attach couplers together with bolts, lockwashers and nuts. Torque to 50 lb.ft. (68 N·m).

NOTE: If propeller shaft coupler has set screws, the shaft should be dimpled at set screw locations. Set screws should be safety wired after being tighten securely.

Engine Connections

IMPORTANT: When routing all wire harnesses and hoses, be sure they are routed and secured to avoid coming in contact with hot spots on engine and avoid contact with moving parts.

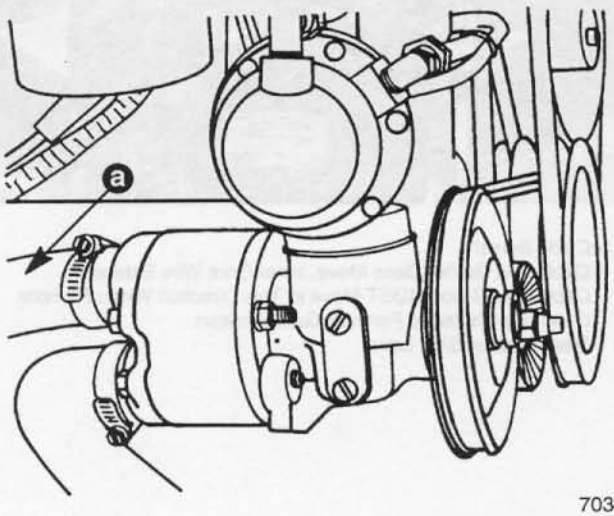
1. Connect seawater inlet hose to seawater pump or combination seawater/fuel pump assembly as shown. Tighten hose clamp securely.



22554

a - Seawater Inlet Hose Connection

Models With Seawater Pump - Bottom Hose

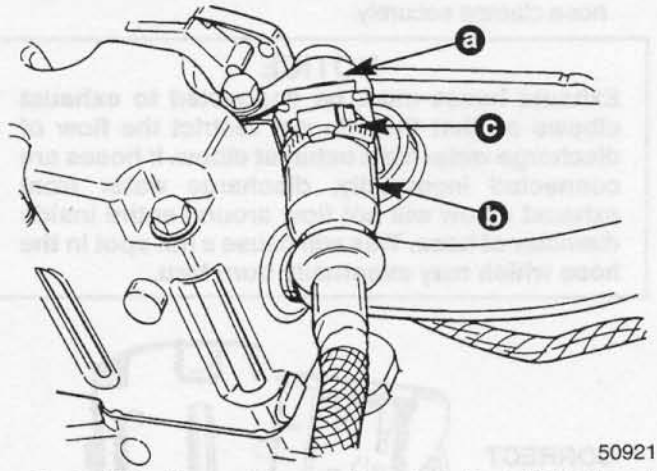


70346

a - Seawater Inlet Hose Connection

Models With Combination Seawater/Fuel Pump - Top Hose

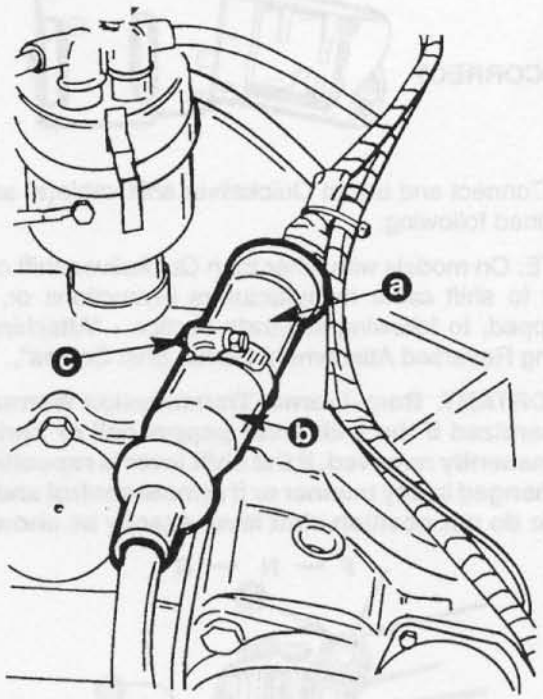
2. Connect instrument harness to engine harness with hose clamp. Tighten hose clamp securely.



50921

a - Engine Wiring Harness Clamp, or Receptacle Bracket (Not Shown)
b - Instrument Wiring Harness Plug
c - Hose Clamp

5.7L/7.4L/8.2L Connection



22556

a - Engine Wiring Harness Connector
b - Instrumentation Wiring Harness Plug
c - Hose Clamp

5.7L Competition Ski and 350 Tournament Ski Connection

⚠ WARNING

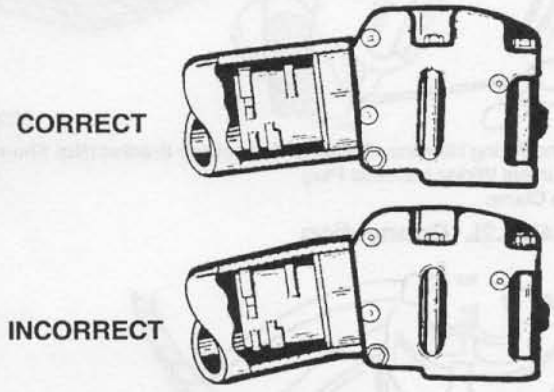
Be careful when working on fuel system. Gasoline is extremely flammable and highly explosive under certain conditions. Do not smoke or allow spark or open flame in area. Wipe up any spilled fuel immediately.

3. Connect fuel line (from fuel tank) to engine. Make certain connection is secure. Check for leaks.

4. Connect exhaust system tubes and hoses using at least two hose clamps at each connection. Tighten hose clamps securely.

NOTICE

Exhaust hoses must be connected to exhaust elbows so that they do not restrict the flow of discharge water from exhaust elbow. If hoses are connected incorrectly, discharge water from exhaust elbow will not flow around entire inside diameter of hose. This will cause a hot spot in the hose which may eventually burn thru.

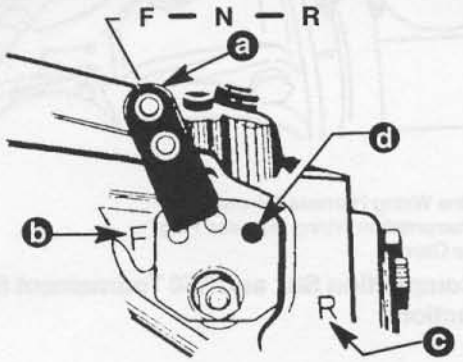


22032

5. Connect and adjust Quicksilver shift cable(s) as outlined following:

NOTE: On models with other than Quicksilver shift cables refer to shift cable manufacturers instructions or, if so equipped, to following separate section - "Attaching/Adjusting Reversed Attachment **Morse** Shift Cables",.

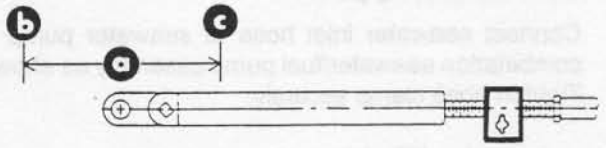
IMPORTANT: Borg–Warner Transmission Warranty is jeopardized if the shift lever poppet ball or spring is permanently removed, if the shift lever is repositioned or changed in any manner or if remote control and shift cable do not position shift lever exactly as shown.



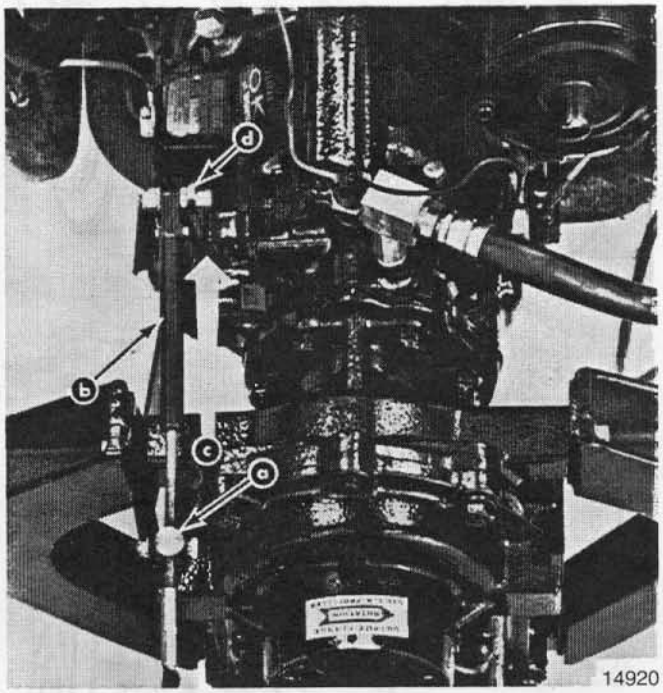
22457

a - Transmission Shift Lever
b - Shift Lever Must Be Over This Letter When Propelling Boat FORWARD
c - Shift Lever Must Be Over This Letter When Propelling Boat in REVERSE
d - Poppet Ball Must Be Centered in Detent Hole for Each F-N-R Position (Forward Gear Shown)

Remote control must provide a total shift cable travel (at transmission end) of at least 2-3/4 in. (70mm) This is necessary to position transmission shift lever fully in the forward and reverse gear positions. Insufficient shift cable travel will cause transmission to slip and eventually fail.



a - 2-3/4 in. (70mm) Minimum
b - Forward Gear
c - Reverse Gear



14920

a - Cable Barrel
b - Cable end Guide (Does Move, Inner Core Wire Extends)
c - Cable End Guide MUST Move in This Direction When Remote Control is Shifted to Forward Gear Position
d - Transmission Shift Lever

IMPORTANT: When installing shift cables, be sure that cables are routed in such a way as to avoid sharp bends and/or contact with moving parts. DO NOT fasten any items to shift cables.

a. Place remote control shift lever, and transmission shift lever in neutral position.

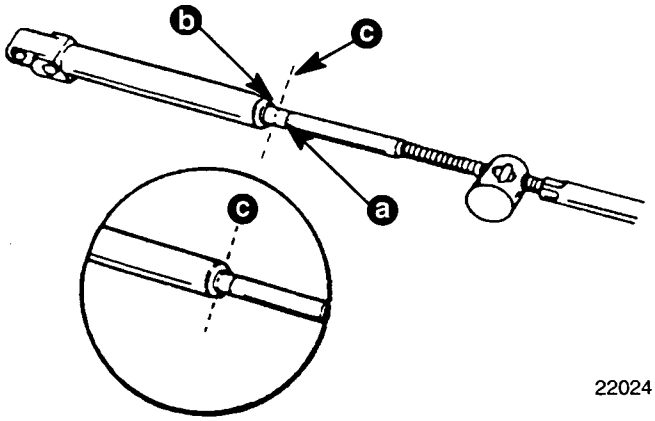
b. Locate center of remote control and control shift cable play (backlash), as follows:

(1) Check that remote control is in neutral position.

(2) Push in on control cable end with enough pressure to remove play, and mark position "a" on tube.

(3) Pull out on control cable end with enough effort to remove play, and mark position "b" on tube.

(4) Measure distance between marks "a" and "b", and mark position "c", half–way between marks "a" and "b".



22024

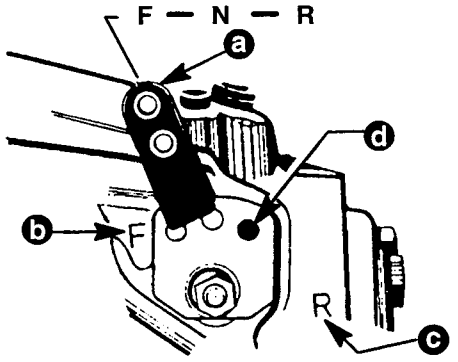
c. Center cable-end play, then adjust cable barrel to align holes in barrel and in cable end guide, with attaching points on transmission.

d. Temporarily install shift cable. Do not secure at this time.

e. Place remote control shift lever in forward gear position and check position of transmission shift lever. Shift lever must be positioned as shown.

⚠CAUTION

Remote control and shift cable must position transmission shift lever exactly as shown, or transmission failure may occur. Do not remove poppet ball or spring.



22457

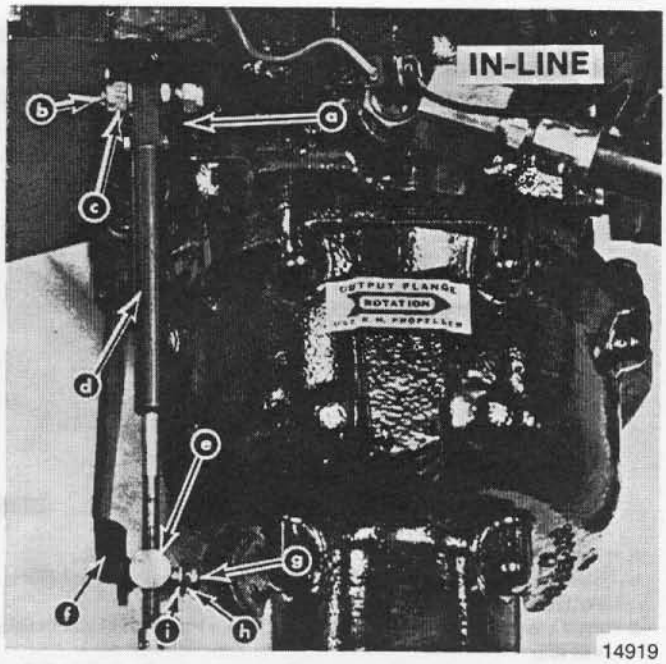
a - Transmission Shift Lever
b - Shift Lever Must Be Over This Letter When Propelling Boat FORWARD
c - Shift Lever Must Be Over This Letter When Propelling Boat in REVERSE
d - Poppet Ball Must Be Centered in Detent Hole for Each F-N-R Position (Forward Gear Shown)

f. Place remote control shift lever in reverse gear position and again check transmission shift lever position. Lever must be positioned as shown by "c".

g. If transmission shift lever will position properly in one gear, but not in the other, recheck shift cable adjustment. If transmission shift lever will not position properly in both gears, move transmission shift lever stud (a), from top hole in shift lever, to bottom hole, and recheck for proper positioning. If proper positioning is still not obtained, remote control does not provide sufficient shift cable travel and must be replaced.

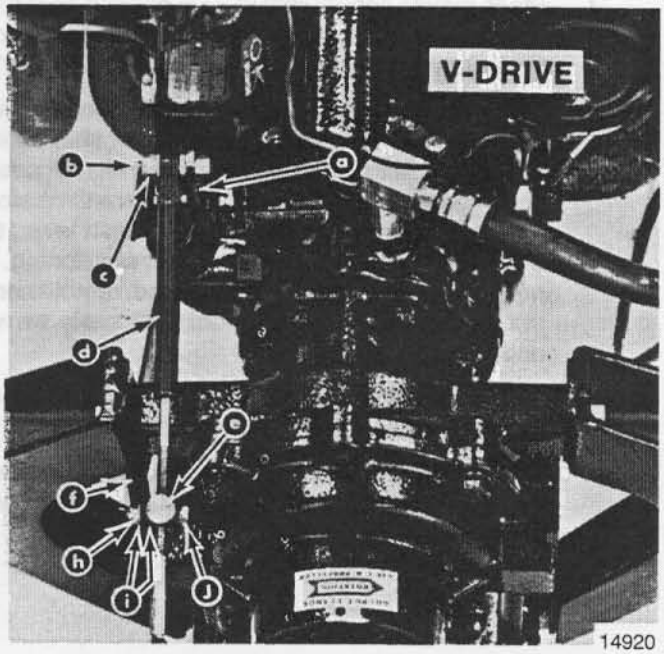
h. Install nut and washer to cable end guide stud. Tighten until snug, then back off one-full turn.

i. Install nut and washer to cable barrel stud. Tighten until they bottom out. Tighten securely, but do not over tighten.



14919

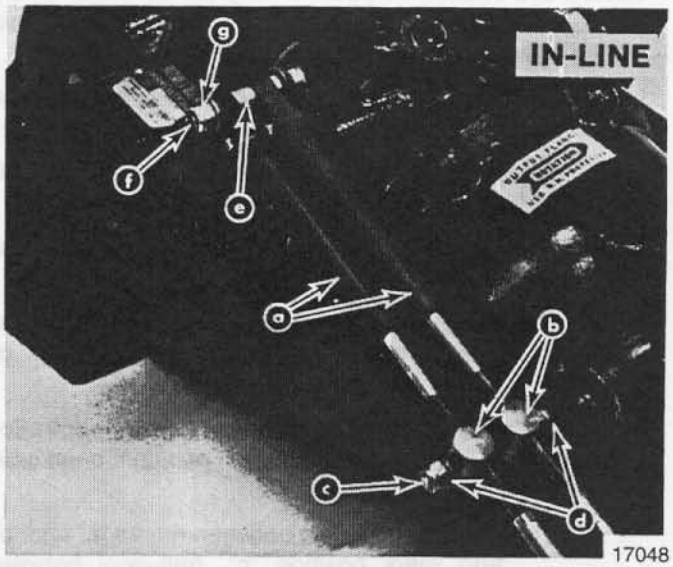
Single Station Installation In–line - Rear Approach



14920

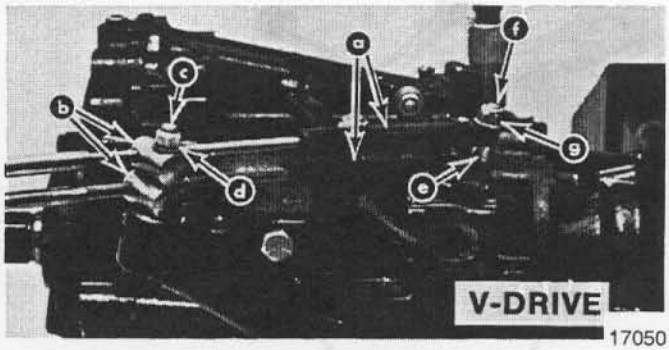
Single Station Installation V-Drive - Rear Approach

a - Shift Lever
b - Shift Lever Stud Cable Barrel
c - Locknut (Thick) and Washer
d - Cable End Guide
e - Cable Barrel
f - Shift Cable Bracket
g - Anchor Stud (In-Line Transmission
h - Locknut
i - Flat Washer
j - Anchor Screw (V-Drive)



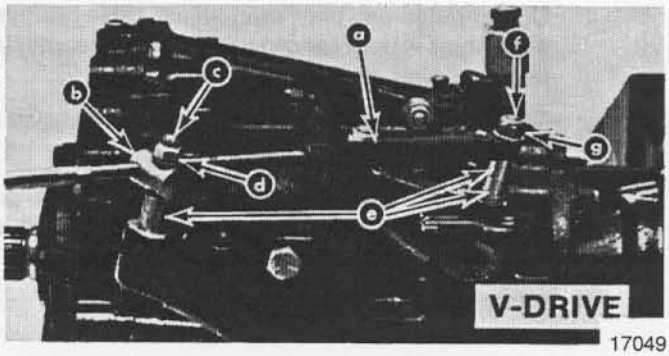
17048

Dual Station Installation In-Line - Rear Approach



17050

Dual Station V-Drive - Front Approach



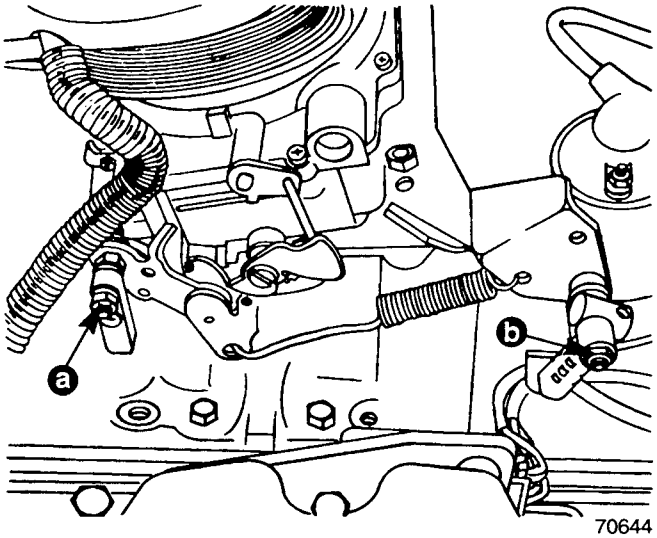
17049

Single Station V-Drive - Front Approach

a - Cable End Guide
b - Cable Barrel
c - Anchor Stud
d - Locknut and Washer
e - Spacer
f - Cable End Guide Stud
g - Locknut and Washer

6. Follow instructions "a" or "b":

   a. **On Models Equipped With Other Than Quicksilver Throttle Cables:** Attach and adjust throttle cables referring to cable manufacturer's instructions.



70644

a - Throttle Lever Stud
b - Cable Anchor Stud

5.7L Competition Ski and 350 Magnum Tournament Ski

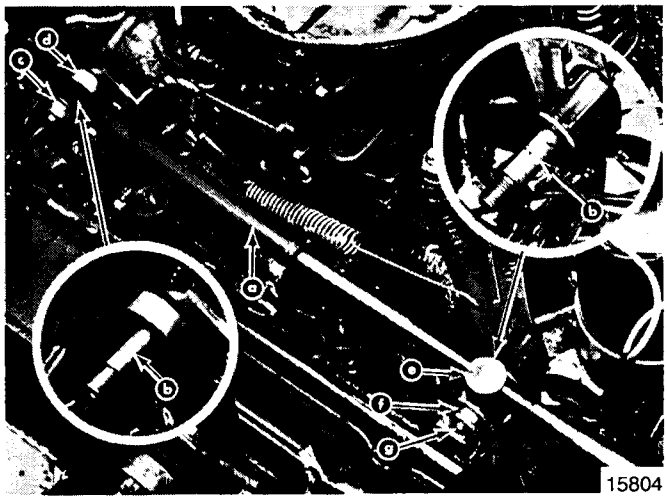
   b. **On Models Equipped With Quicksilver Throttle Cables:** Connect and adjust throttle cable(s) as outlined following:

      (1) Place remote control throttle lever(s) in idle position.

      (2) Install cable end guide on carburetor throttle lever stud as shown. Push cable barrel lightly toward throttle lever (This will place a slight preload on cable to avoid slack in cable when moving remote control levers.). Then adjust cable barrel to align with anchor stud and slide barrel onto stud.

      (3) Secure throttle cable with hardware as shown. Tighten cable end guide locknut until it bottoms out and then back off 1 full turn. Tighten barrel locknut until secure, but DO NOT OVER TIGHTEN as cable(s) must be able to pivot.

SINGLE STATION

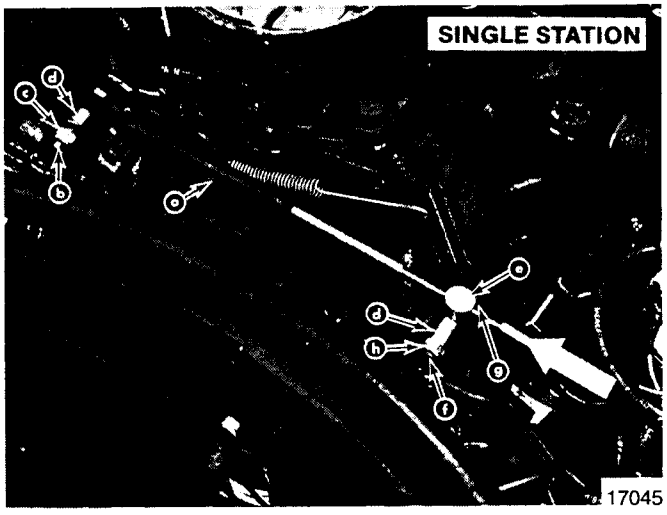


15804

a - Cable End Guide
b - Bushing
c - Washer, Locknut and Throttle Lever Stud
d - Spacer
e - Barrel
f - Washer and Locknut
g - Anchor Stud

Rochester or Weber Carburetor

NOTE: Refer to the following for installations where dual station length anchor studs are present but only a single station cable has been installed.

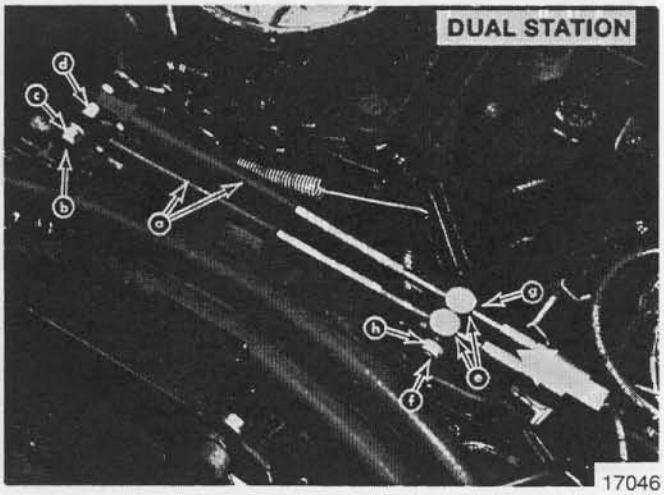


17045

Rochester or Weber Carburetor

a - Cable End Guide
b - Anchor Stud, Throttle Lever
c - Washer and Locknut
d - Spacer
e - Barrel
f - Anchor Stud
g - Bushing (Hidden In This View)
h - Washer and Locknut

DUAL STATION



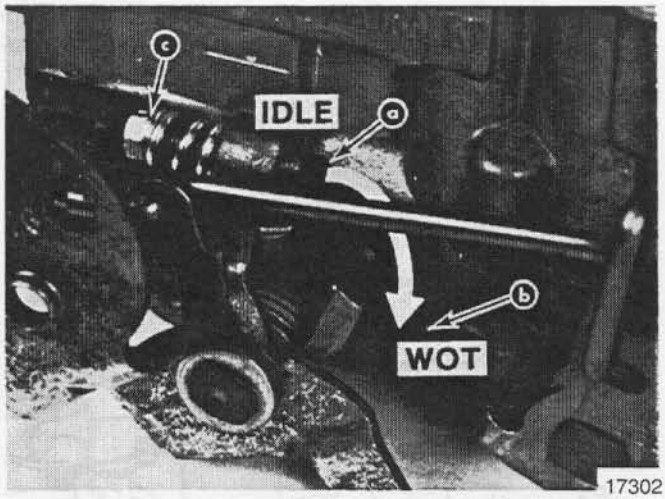
a - Cable End Guide(s)
b - Anchor Stud, Throttle Lever
c - Washer and Locknut
d - Spacer
e - Barrel(s)
f - Anchor Stud
g - Bushings (Hidden In This View)
h - Washer and Locknut

Rochester or Weber Carburetor

(4) Place remote control throttle lever(s) in the wide-open-throttle (W.O.T.) position. Check to ensure that throttle shutters (valves) are completely open.

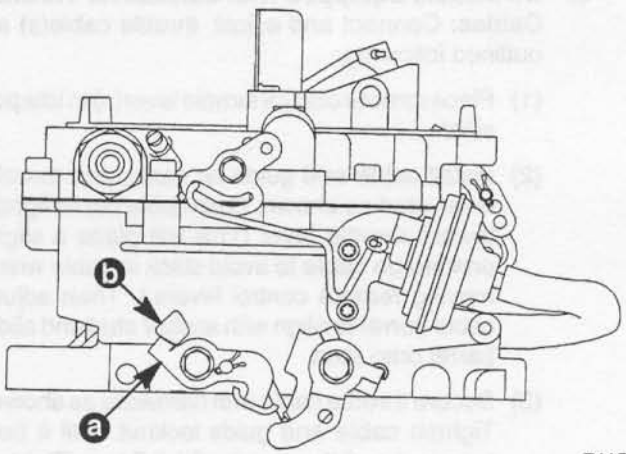
(5) Return remote control throttle lever to idle position and check to ensure that throttle lever contacts idle speed adjustment screw.

MODELS WITH ROCHESTER 4 BARREL CARBURETOR



a - Tang
b - Carburetor Body
c - Idle RPM Adjustment Screw

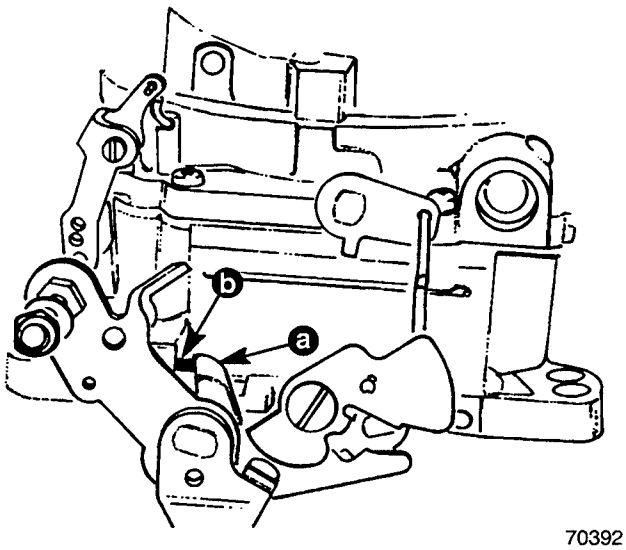
MODELS WITH WEBER 4 BARREL CARBURETOR



a - Throttle Shaft Lever (Contacts "b" at W.O.T. Position)
b - Carburetor Body Casting

Wide-Open-Throttle Position Shown

MODELS WITH WEBER 4 BARREL CARBURETOR (Continued)

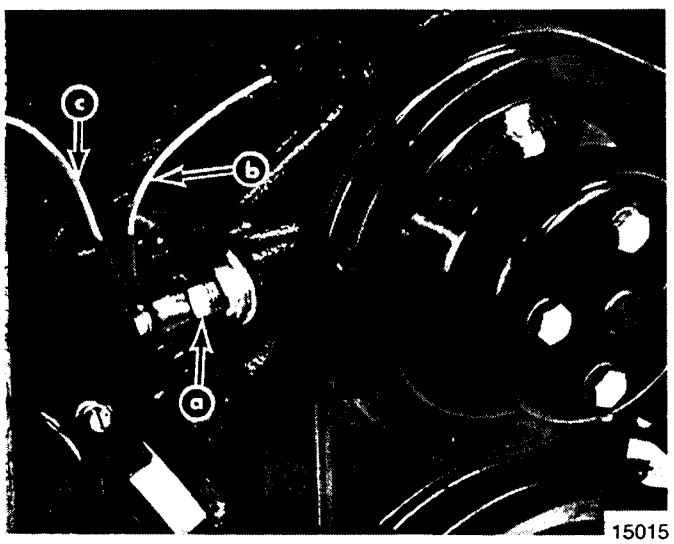


70392

a - Throttle Lever (Contacts "b" In Idle Position)
b - Idle Speed Adjustment Screw

Idle Position Shown

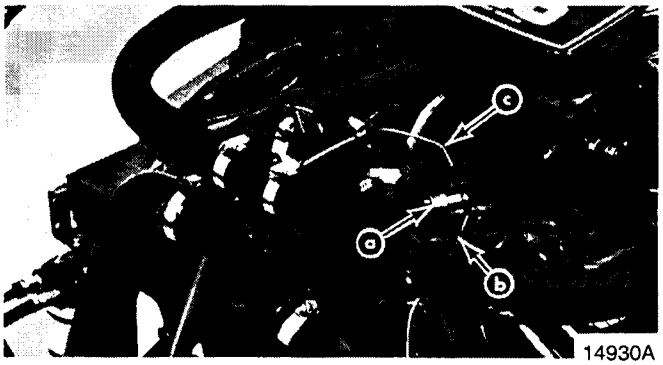
7. Connect any ground wires or accessories that may have been disconnected from engine.
8. If not part of main engine wiring harness, connect audio warning system Tan/Blue wire (from buzzer) at engine heat switch as shown using nut and lockwasher. Tighten securely and coat terminals with Quicksilver Liquid Neoprene.



15015

a - Water Heat Switch
b - Tan/Blue Wire (Jumper Wire to Engine Oil Pressure Switch)
c - Disconnect Tan/Blue Wire (From Buzzer)

Early MIE 5.7L Model Engine Shown



14930A

a - Water Heat Switch
b - Tan/Blue Wire (Jumper Wire to Engine Oil Pressure Switch)
c - Disconnect Tan/Blue Wire (From Buzzer)

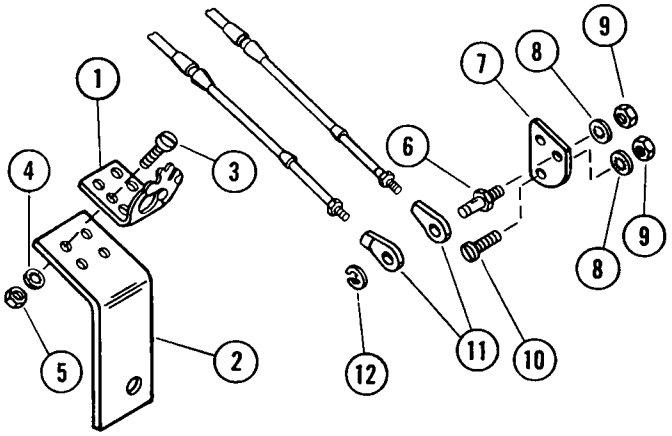
Early MIE 7.4L Model Engine Shown

9. Connect battery cables to battery by FIRST connecting Positive (+) battery cable end to Positive (+) battery terminal. Tighten clamp securely. THEN, connect Negative (–) battery cable end to Negative (–) battery terminal. Tighten clamp securely.

Attaching/Adjusting Reversed Attachment Morse Shift Cables

1. Disconnect battery cables from battery.

MORSE MARINE PRODUCTS PART NUMBER A35627



Item No.	Description	No. Req'd	Part No.
1	Cable Clip	1	A35531
2	Bracket	1	B35762
3	Screw, Mach., Fill. Hd. # 10-32 x 1/2" 1/2" Long	2	A50112-545
4	Lockwasher, Internal Tooth, #10	2	A50803-059
5	Nut, Hex, #10-32	2	A50900-076
6	Pivot Pin	1	A300965
7	Adaptor Plate	1	A47151
8	Lockwasher, Internal Tooth, 14"	2	A50803-077
9	Nut, Hex, 1/14-28	2	A50901-016
10	Screw, Mach., Flat Hd. 1/4-28 x 5/8"Long	1	A50120-561
11	Cable Terminal	2	A300646
12	E-Ring 5/16"	1	Comm"l.

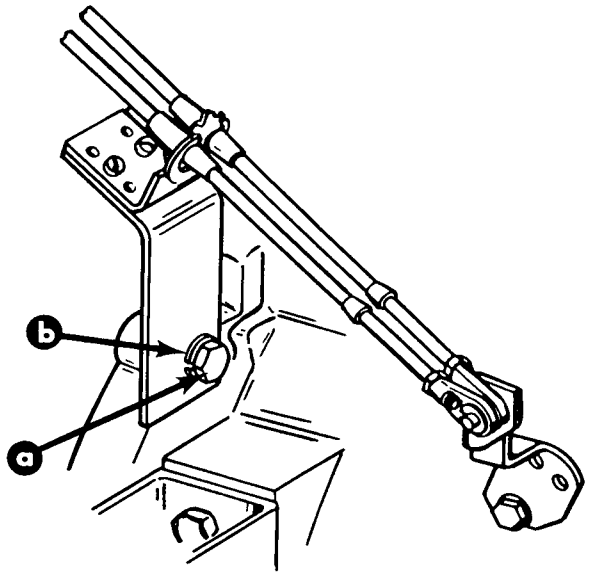
If your engine/transmission package is equipped with the above or is being equipped with the above Morse Marine cables observe the following:

2. Place remote control and transmission shift lever in neutral.

IMPORTANT: Remote control must provide a total shift cable travel (at transmission end) of at least 2-3/4 in. (70mm) This is necessary to position transmission shift lever fully in the forward and reverse gear positions. Insufficient shift cable travel will cause transmission to slip and eventually fail.

3. Attach cable clip (1) to bracket (2) using screws (3), lockwashers (4) and nuts(5). Use center holes in cable clip for Models 70 and 71: use holes farthest from cable lock for Model 72.

4. Remove top transmission mounting bolt (a) and lockwasher (b) from left (valve) side of transmission; position bracket, replace bolt and lockwasher.



a - Bolt
b - Lockwasher

5. Fasten pivot pin (6) securely through hole (not countersunk) in adaptor plate (7) using lockwasher (8) and nut (9).

6. Attach adapter plate (7) to transmission shift lever using screw (10), lockwasher (8) and nut (9).

7. Fasten cable hubs in cable clip (1) and screw terminals (11) onto cable rods until holes in terminals line up with pivot pin. Hold each terminal securely to prevent from turning and tighten cable nut against terminal.

NOTE: Be sure control head hand lever and transmission shift lever are in neutral position during the above installation.

8. Place terminals on pivot pin and secure with E–ring (12).

NOTE: When using this kit with Models "S" or "SR" controls, adjust the stop screws in the control head to prevent cable from jamming the clutch arm against its stops at forward and reverse.

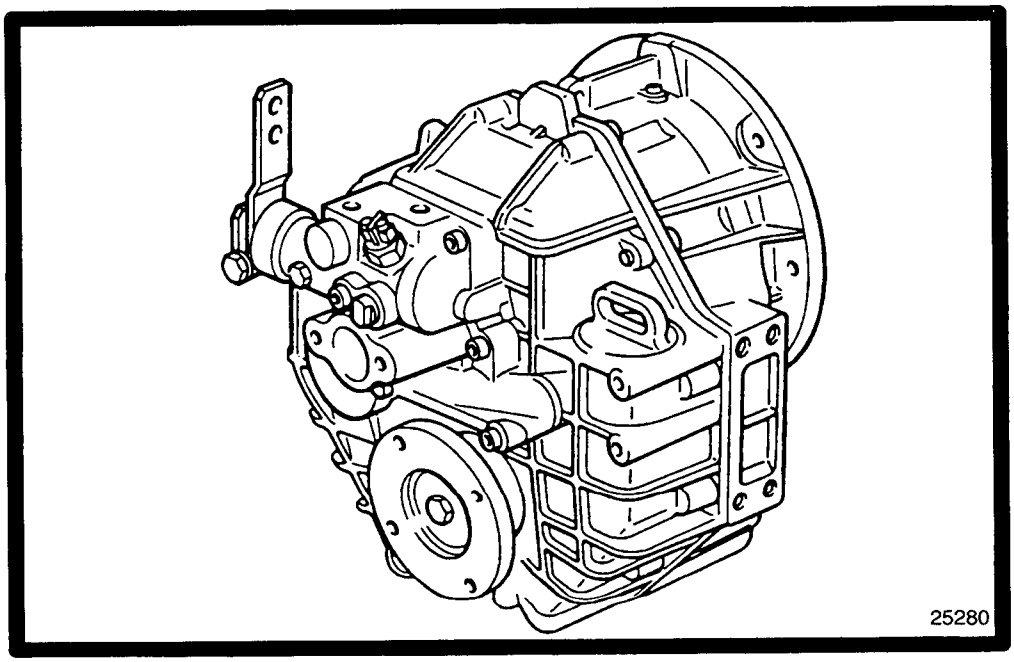
9. Refer to control head installation instructions for final check and adjustment procedures.

10. Connect battery cables to battery by FIRST connecting Positive (+) battery cable end to Positive (+) battery terminal. Tighten clamp securely. THEN, connect Negative (–) battery cable end to Negative (–) battery terminal. Tighten clamp securely.

REMOVAL AND INSTALLATION

2

F



MIE MODELS WITH HURTH TRANSMISSION

Table of Contents

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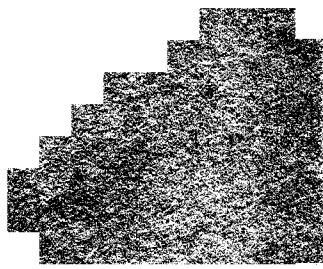
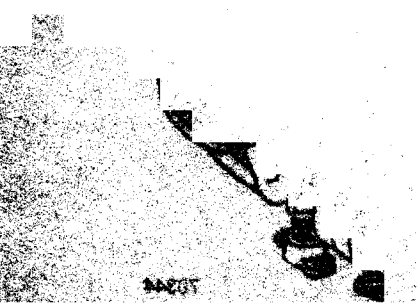


TORQUE SPECIFICATIONS

FASTENER LOCATION		LBS. FT. (N·m)
Battery Cables		Securely
Engine Mount Pads		Securely
Hose Clamps		Securely
Mount Locking Nut		Securely Note 2
Propeller Shaft Coupler-to-Transmission Output Flange		50 (68)
Remote Control Shift Cable	Brass Barrel	Securely
	Cable End Guide	Note 1
Remote Control Throttle Cable	Brass Barrel	Securely
	Cable End Guide	Note 1
Trunnion Clamping Screw/Nut		50 (68)

Note 1: Tighten, then back nut off 1 full turn.

Note 2: Bend tab against adjusting nut.

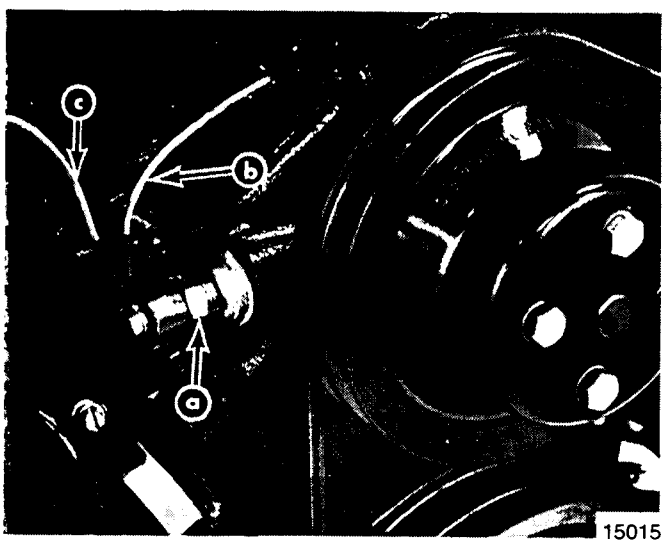


LUBRICANTS/SEALERS

LUBRICANTS	
92-86154A1	Quicksilver 2-4-C Marine Lubricant
92-25711	Quicksilver Liquid Neoprene

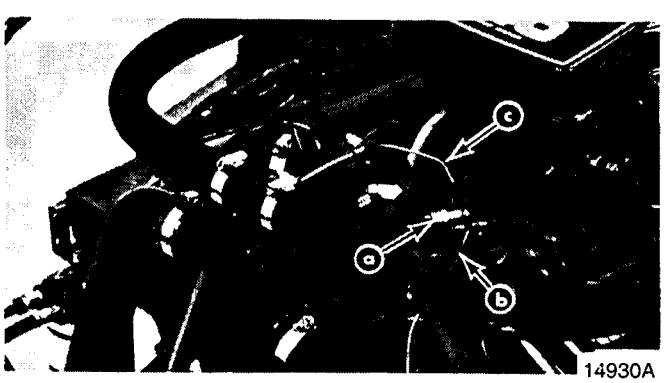
Removal

1. Disconnect battery cables from battery.
2. Remove instrument panel harness connector plug from engine harness receptacle.
3. Disconnect fuel line (from fuel tank) from engine.
4. Disconnect throttle cable from carburetor.
5. Disconnect shift cable from transmission.
6. Disconnect seawater inlet hose from engine.
7. Disconnect exhaust system hoses.
8. Disconnect any ground wires or accessories that are connected to engine.
9. If not part of main engine wiring harness, disconnect audio warning system Tan/Blue wire (from buzzer) at engine heat switch as shown.



a - Water Heat Switch
b - Tan/Blue Wire (Jumper Wire to Engine Oil Pressure Switch)
c - Disconnect Tan/Blue Wire (From Buzzer)

Early MIE 5.7L Model Engine Shown



a - Water Heat Switch
b - Tan/Blue Wire (Jumper Wire to Engine Oil Pressure Switch)
c - Disconnect Tan/Blue Wire (From Buzzer)

Early MIE 7.4L Model Engine Shown

10. Disconnect propeller shaft coupler from transmission output flange.

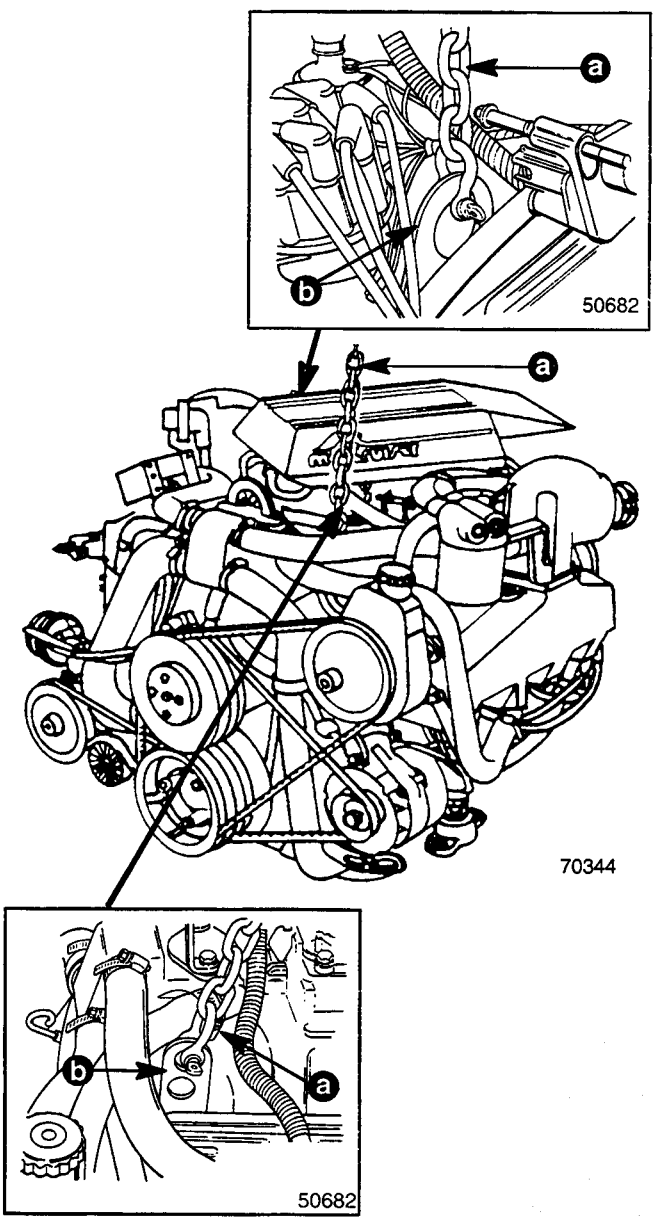
⚠CAUTION

Center lifting eye (located on top of thermostat housing) is used for engine alignment only. Do not use to lift entire engine.

⚠CAUTION

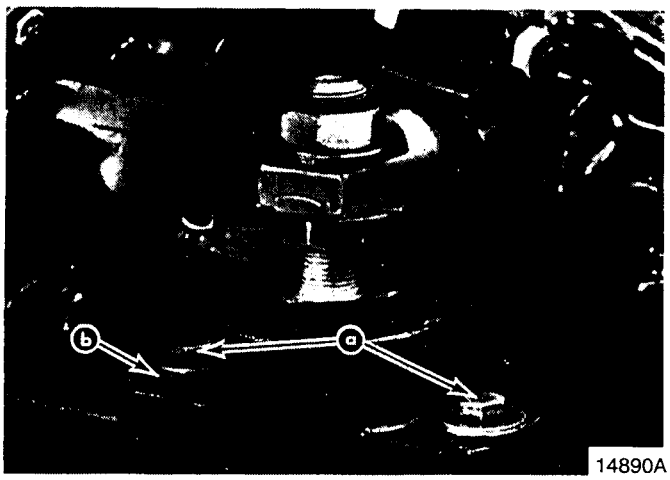
Do not allow lifting sling to hook or compress engine components or damage to them will occur.

11. Support engine with suitable sling thru lifting eyes on engine.



a - Suitable Sling
b - Engine Lifting Eyes

12. Remove front and rear engine mounting bolts. Retain hardware.



14890A

a - Bolts or Lag Screws (With Washers)

13. Carefully remove engine.

Installation

Engine Installation and Initial Alignment

1. Follow instructions "a" or "b":
   a. **Engine mount(s) or adjustment WAS NOT DISTURBED during engine service:** Proceed to following step 2.
   b. **Engine mount(s) or adjustment WAS DISTURBED during engine service:**

IMPORTANT: Engine mounts must be adjusted, as explained in the following, to center mount adjustment and establish a uniform height on all mounts.

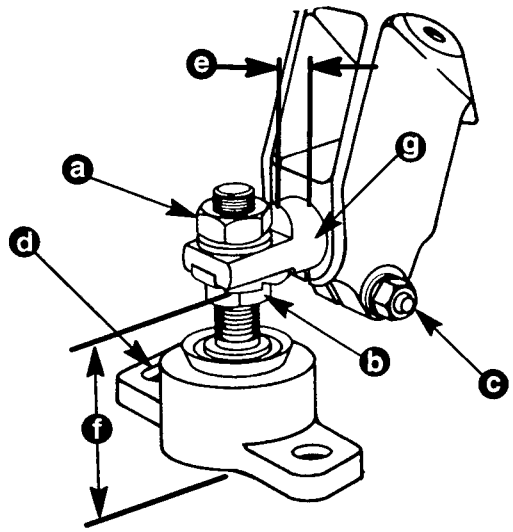
Ensure that all mounts are:

(1) In the center of their up-and-down adjustment.

(2) Mounting hole which is a slot is forward (if so designed, new style are not slotted).

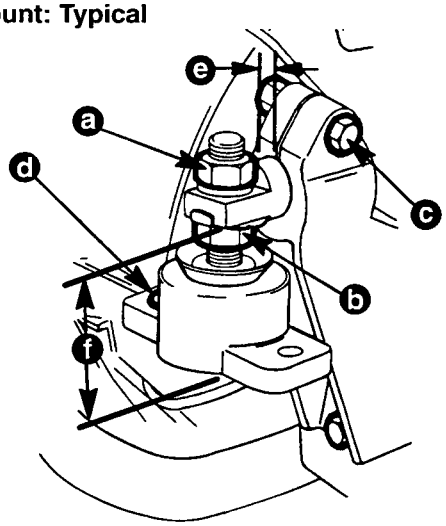
(3) Large diameter of mount trunnion extended as shown.

(4) Each mount base is downward. Tighten clamping screws and nuts slightly to prevent moving in or out. Mounts must be free to pivot when installing engine.



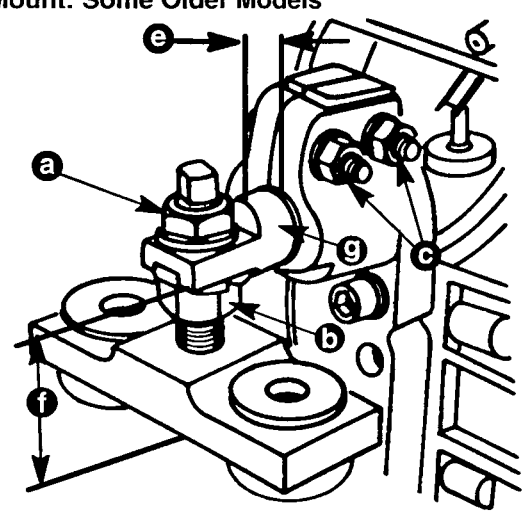
70140

Front Mount: Typical



22555

Rear Mount: Some Older Models



70158

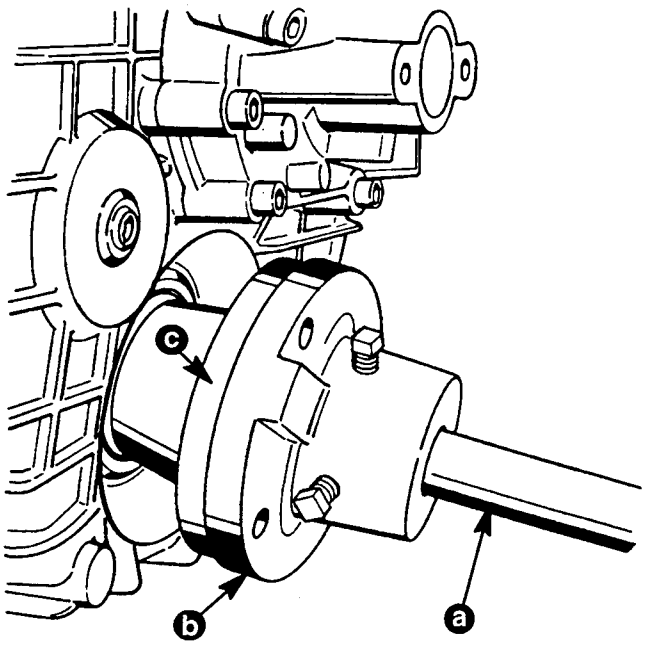
Rear Mount: Some Newer Models

a - Locking Nut
b - Adjusting Nut
c - Trunnion Clamp Screw and Nut, With Lockwasher
d - Slot Forward
e - 3/8 in. ± 1/16 in. (10mm ± 2mm)
f - 2-5/8 in. ± 1/16 in. (67mm ± 2mm)
g - Mount Trunnion

2. Attach a suitable sling to lifting eyes on engine (refer to removal section for location of lifting eyes).
3. Follow instructions "a" or "b":

IMPORTANT: Engine bed must position engine so that a minimum of 1/4 in. (6mm) up-and-down adjustment still exists on all 4 mounts after performing final alignment. This is necessary to allow for final engine alignment.

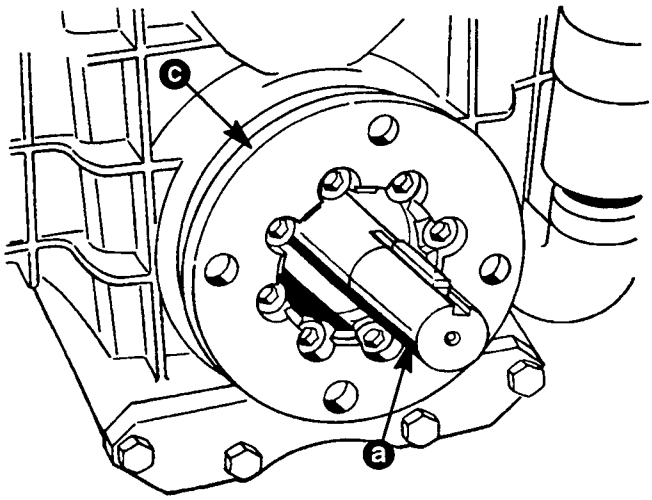
a. **MODELS WITH DOWN ANGLE TRANSMISSION:** Lift engine into boat and position on engine bed so that transmission output flange and propeller shaft coupler are visibly aligned (no gap can bee seen between coupling faces when butted together). **Adjust engine bed height,** if necessary, to obtain proper alignment. DO NOT use mount adjustments to adjust engine position at this time.



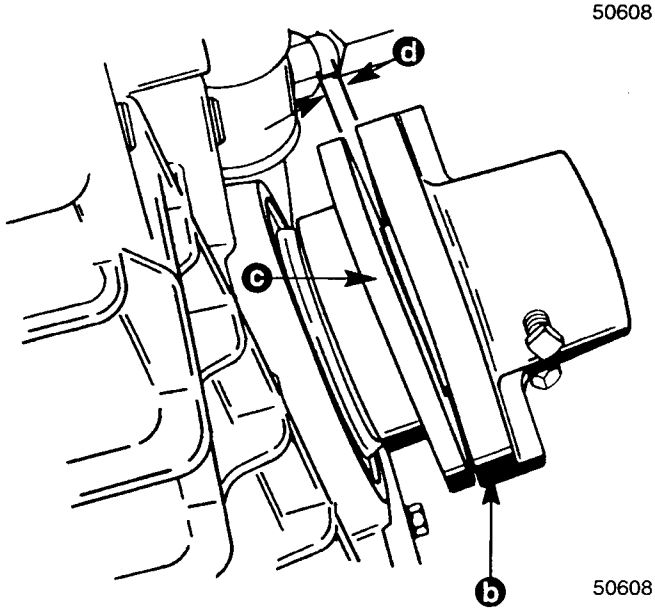
50609

a - Propeller Shaft
b - Propeller Shaft Coupler
c - Transmission Output Flange

b. **MODELS WITH V–DRIVE TRANSMISSION:** Lift engine into boat and position so that enough propeller shaft protrudes thru transmission and output flange for propeller shaft coupler to be attached. Then, install coupler and position engine (no gap can be seen between coupling faces when butted together). **Adjust engine bed height,** if necessary, to obtain proper alignment. DO NOT use mount adjustments to adjust engine position at this time.



50608

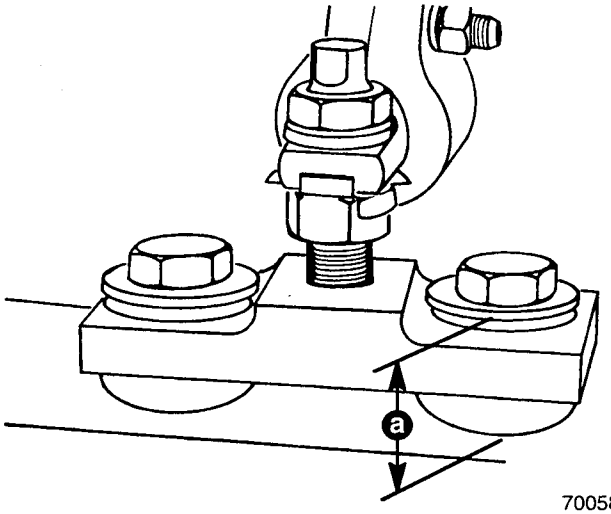


50608

a - Propeller Shaft
b - Propeller Shaft Coupler
c - Transmission Output Flange
d - **No Gap Allowed**

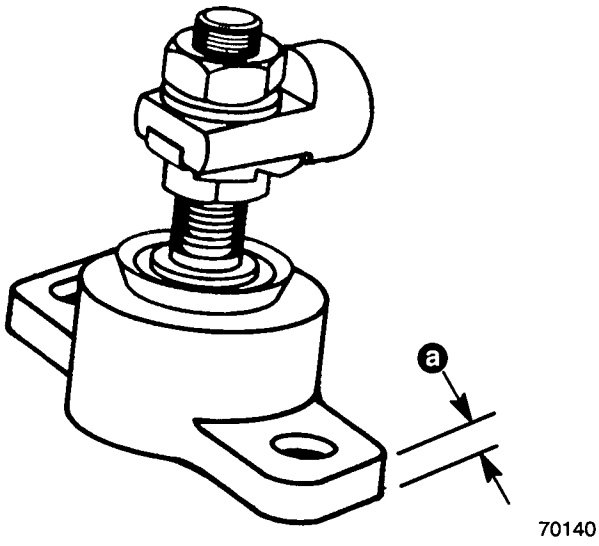
4. Check all four mounts to ensure that they are still positioned properly; then fasten mounts to engine bed with appropriate bolts or lag screws, and hardware. Tighten lag bolts/screws securely.

IMPORTANT: If equipped with new style rear mounts, longer lag screws should have been used. Be certain to install appropriate length lag screw or fastener on new style rear mounts.



a - 1-1/2 in. (39mm)

New Style Rear Mount (Longer Fasteners Required)



a - 1/2 in. (13mm)

Early Style Rear Mount (Similar to Front Mount)

5. Disconnect and remove sling. Proceed to "Engine Final Alignment" section following.

Engine Final Alignment

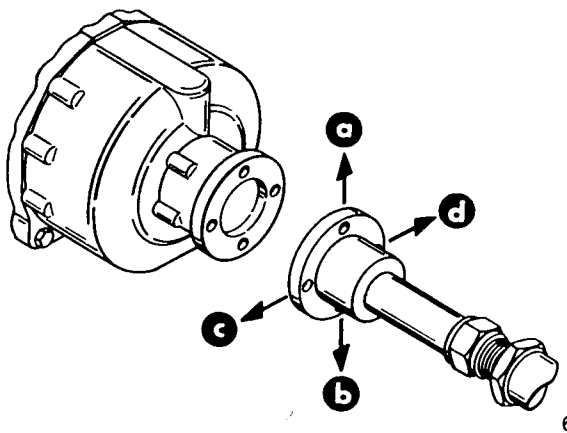
⚠CAUTION

To avoid vibration, noise, and damage to transmission output shaft oil seal and bearings, engine must be properly aligned.

IMPORTANT: Engine alignment MUST BE RECHECKED with boat in the water, fuel tanks filled and with a normal load onboard.

Engine must be aligned so that transmission output flange and propeller shaft coupler centerlines are aligned and coupling faces are parallel within .003 in. (0.07mm). This applies to installations with solid couplings, as well as flexible couplings.

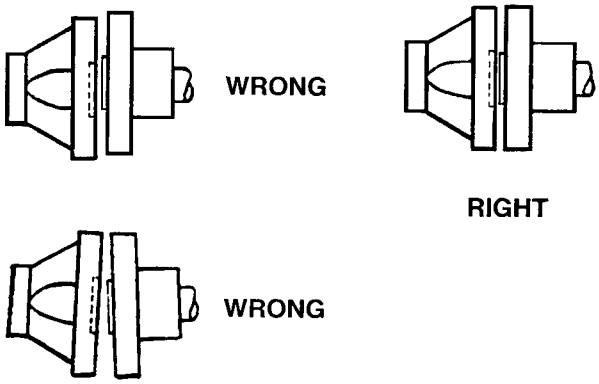
1. Check mating surfaces on transmission output flange and propeller shaft coupler faces to make sure they are clean and flat.
2. Follow instructions "a" or "b":
   a. **On V–Drive Transmission Models:** proceed to Step 3. following.
   b. **On Down Angle Transmission Models:** Center propeller shaft in shaft log as follows:
      (1) Push down and then lift shaft as far as it will move. Then place shaft in the middle of the movement.
      (2) Move shaft to port and then to starboard as far as shaft will move. Then place shaft in the middle of the movement.
      (3) With shaft in center of shaft log, as determined by above procedures "a" and "b", align engine to shaft.



a - Up
b - Down
c - Port
d - Starboard

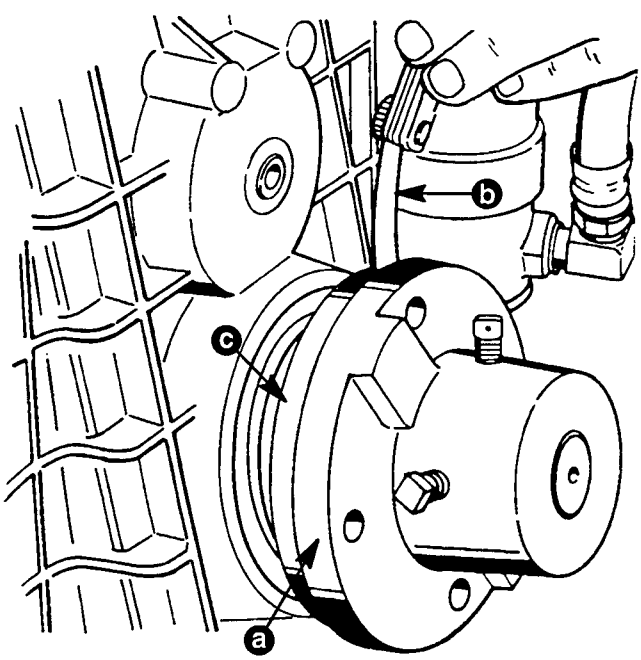
3. Check that coupling centerlines align, by butting propeller shaft coupler against transmission output flange. Shoulder on propeller shaft coupler should engage recess on transmission output flange face with no resistance.

NOTE: Some propeller shaft couplers may not have a shoulder on mating face. On these installations, use a straight edge to check centerline alignment.



22457

4. Check for angular misalignment, by hand holding coupling faces tightly together and checking for a gap between faces with a .003 in. (0.07mm) feeler gauge at 90° intervals.



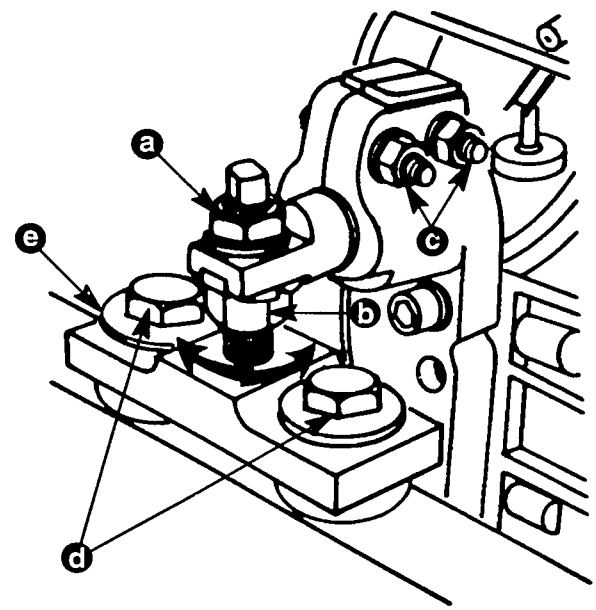
50609

a - Propeller Shaft Coupler
b - Feeler Gauge (Check at 90 Degree Intervals)
c - Transmission Output Flange

V-Drive Version Shown (Down Angle Similar)

5. If coupling centerlines are not aligned or if coupling faces are more than .003 in. (0.07mm) out-of-parallel, adjust and retighten engine mounts as follows:
   a. TO ADJUST ENGINE UP OR DOWN: Loosen locking nut on mounts requiring adjustment and turn both front mounts or rear mounts adjusting nuts equally.

IMPORTANT: Both front mounts (or rear mounts) adjusting nuts must be turned equally to keep engine level from side to side.



70056

a - Locking Nut
b - Adjusting Nut
c - Clamping Screws and Nuts, with Lockwashers (Only One Each On Some Mounts)
d - Lag Screws (or Bolts)
e - Slot Forward (If So Designed - NOT Slotted On This Style Rear Mount)

Typical Mount

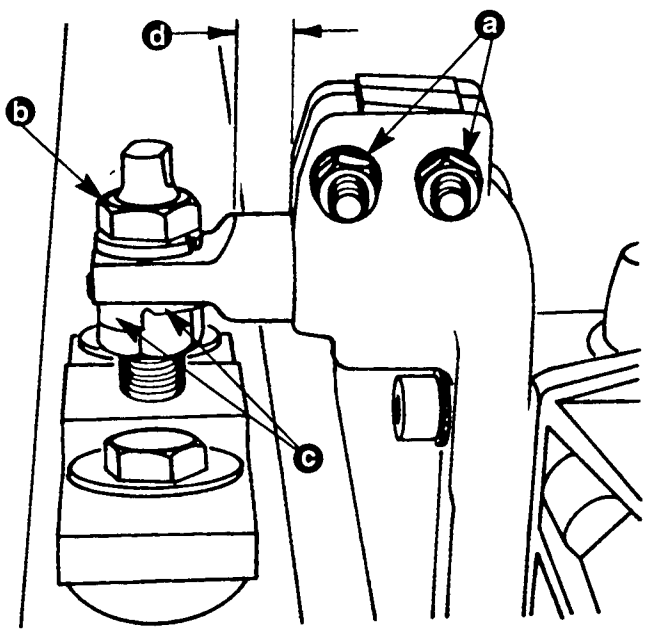
NOTE: Engine mount shown is typical. All models are similar and adjust in the same manner.

b. TO MOVE ENGINE TO THE LEFT OR RIGHT: Loosen clamping screw and nut on all 4 mount brackets and move engine to the left or right as necessary, to obtain proper alignment. On mounts which do have a slotted hole, a small amount of adjustment can be obtained with slot on front end of mounts. Loosen lag screws or bolts (which fasten mounts to engine bed) and move engine, as required. Tighten lag screws or bolts securely.

c. After engine has been properly aligned: Tighten engine mount nuts securely, and be certain to bend one of the tabs on the tab washer down onto flat of mount adjusting nut. Torque clamping screws and nuts to 50 lb. ft. (68 N·m).

NOTE: Some rear mounts have only one (1) clamping screw and nut, on each side instead of the style with two shown following.

IMPORTANT: Large diameter of mount trunnion MUST NOT extend over 3/4 in. (20mm) from mount brackets on any of the mounts.



70057

a - Torque Clamping Screws and Nuts on All 4 Mount Brackets to 50 lb.ft.(68 N·m)
b - Tighten Locking Nut On All 4 Mounts Securely
c - Bend One of the Tabs on Tab Washer Down onto Flat of Adjust ing Nut
d - Maximum Extension of Large Diameter of Trunnion 3/4 in. (20mm)

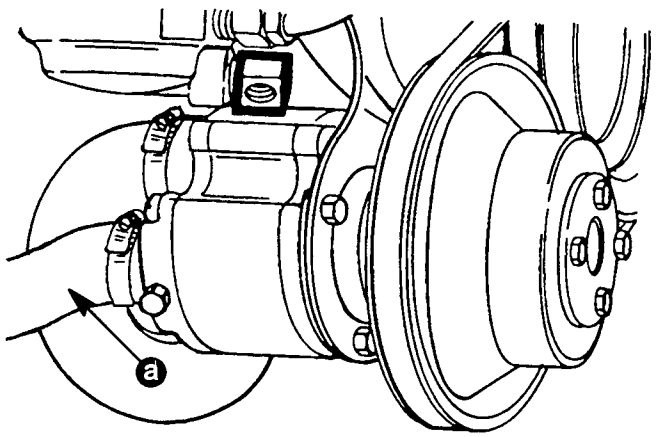
6. Connect propeller shaft coupler to transmission output flange. Attach couplers together with bolts, lockwashers and nuts. Torque to 50 lb.ft. (68 N·m).

NOTE: If propeller shaft coupler has set screws, the shaft should be dimpled at set screw locations. Set screws should be safety wired after being tighten securely.

Engine Connections

IMPORTANT: When routing all wire harnesses and hoses, be sure they are routed and secured to avoid coming in contact with hot spots on engine and avoid contact with moving parts.

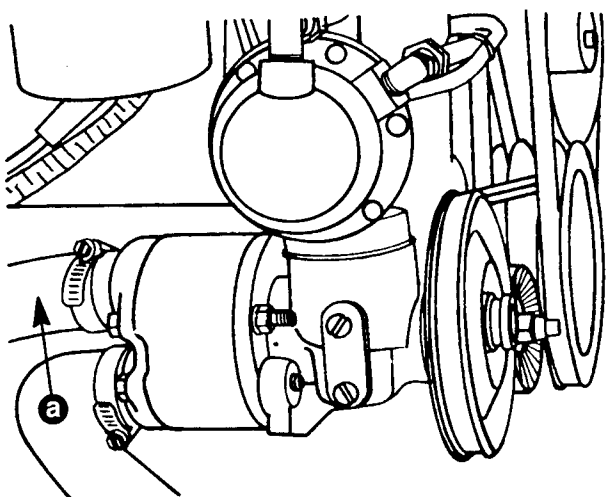
1. Connect seawater inlet hose to seawater pump or combination seawater/fuel pump assembly as shown. Tighten hose clamp securely.



22554

a - Seawater Inlet Hose Connection

Models With Seawater Pump - Bottom Hose

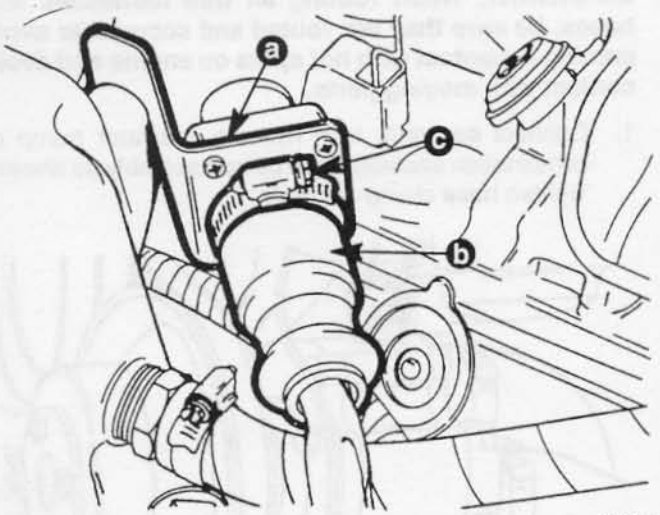


70346

a - Seawater Inlet Hose Connection

Models With Combination Seawater/Fuel Pump - Top Hose

2. Connect instrument harness to engine harness with hose clamp. Tighten hose clamp securely.



22557

a - Engine Wiring Harness Receptacle Bracket/Clamp
b - Instrument Wiring Harness Plug
c - Hose Clamp

7.4L/8.2L Bracket Connection

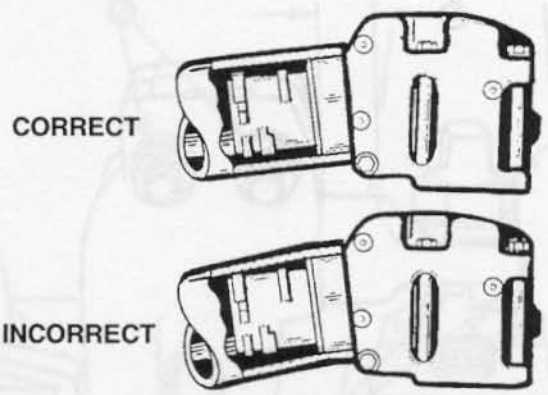
⚠ WARNING

Be careful when working on fuel system. Gasoline is extremely flammable and highly explosive under certain conditions. Do not smoke or allow spark or open flame in area. Wipe up any spilled fuel immediately.

3. Connect fuel line (from fuel tank) to engine. Make certain connection is secure. Check for leaks.
4. Connect exhaust system tubes and hoses using at least two hose clamps at each connection. Tighten hose clamps securely.

NOTICE

Exhaust hoses must be connected to exhaust elbows so that they do not restrict the flow of discharge water from exhaust elbow. If hoses are connected incorrectly, discharge water from exhaust elbow will not flow around entire inside diameter of hose. This will cause a hot spot in the hose which may eventually burn thru.



22032

5. Connect and adjust shift cable(s) as outlined following:

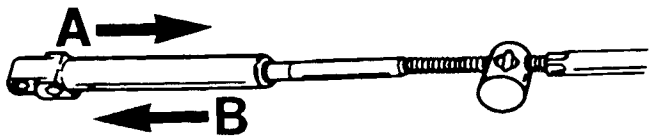
IMPORTANT: When installing shift cables, be sure that cables are routed in such a way as to avoid sharp bends and/or contact with moving parts. DO NOT fasten any items to shift cables.

IMPORTANT: These Hurth transmissions are full reversing transmissions. Direction of output/propeller rotation is determined by hookup of shift cable at remote control.

NOTE: Shift cable must be hooked up to remote control before starting installation and adjustment procedures.

For Standard Left Hand Rotation – shift cable hookup at remote control must result in shift cable end guide moving in direction "B", when remote control handle is placed in forward position.

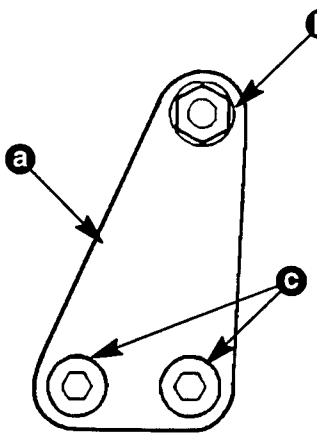
For Right Hand Rotation – shift cable hookup at remote control must result in shift cable end guide moving in direction "A", when remote control handle is placed in forward position.



23242

a. Follow instructions (1) or (2):

(1) On early style bracket: Anchor stud for shift cable should be installed as shown.



71040

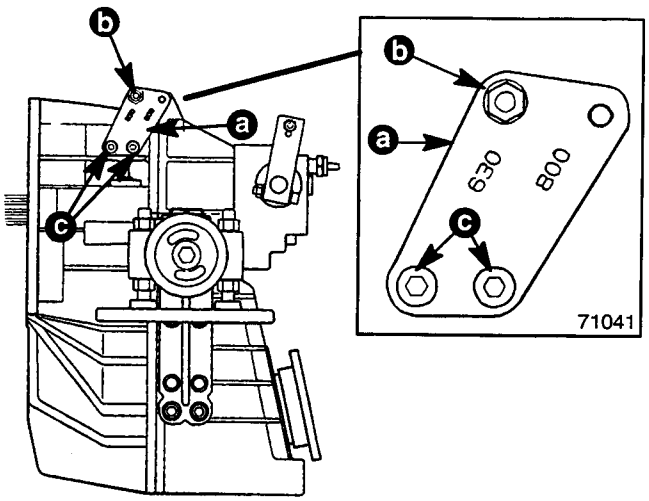
Early Style Shift Cable Bracket

a - Bracket, Shift Cable
b - Shift Cable Anchor Stud
c - Bracket-to-Transmission Fasteners

(2) On late style bracket (with two anchor location holes): Be certain anchor stud is installed in the hole marked appropriate for your transmission (Refer to Transmission Identification Plate for specific transmission model designation.).

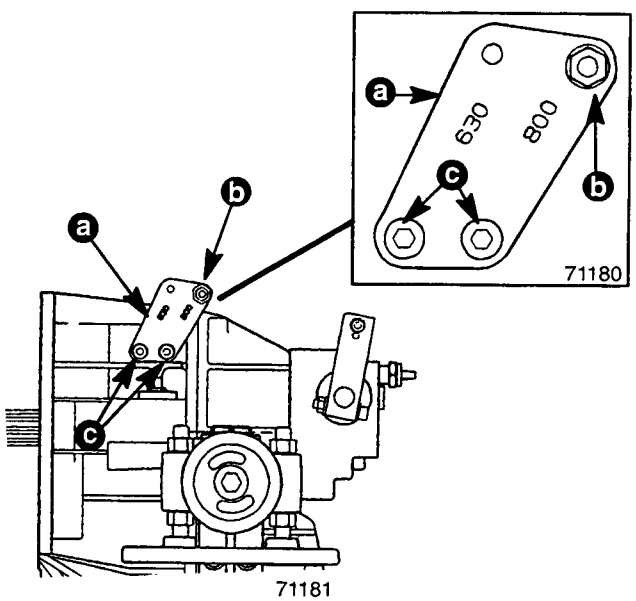
⚠ WARNING

Avoid serious personal injury or property damage caused by improper shifting. Anchor stud for shift cable must be installed in the correct hole when using "late style" bracket.



71020

Late Style Shift Cable Bracket - Anchor Stud Position Shown For 630 Transmission

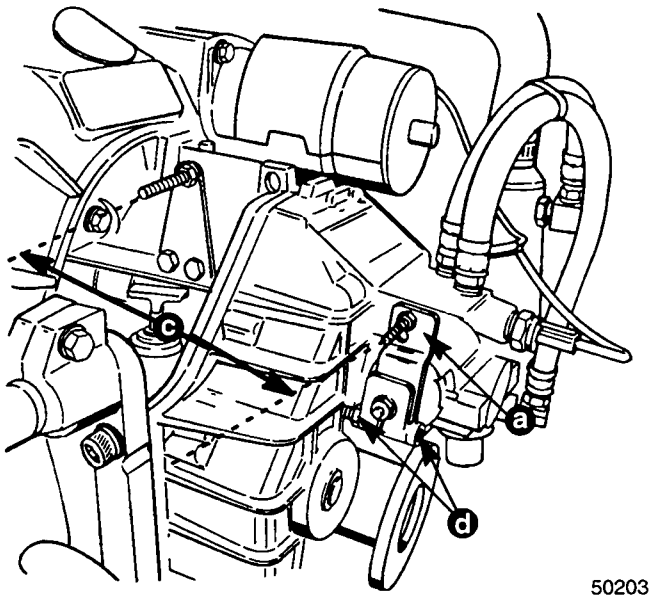


71181

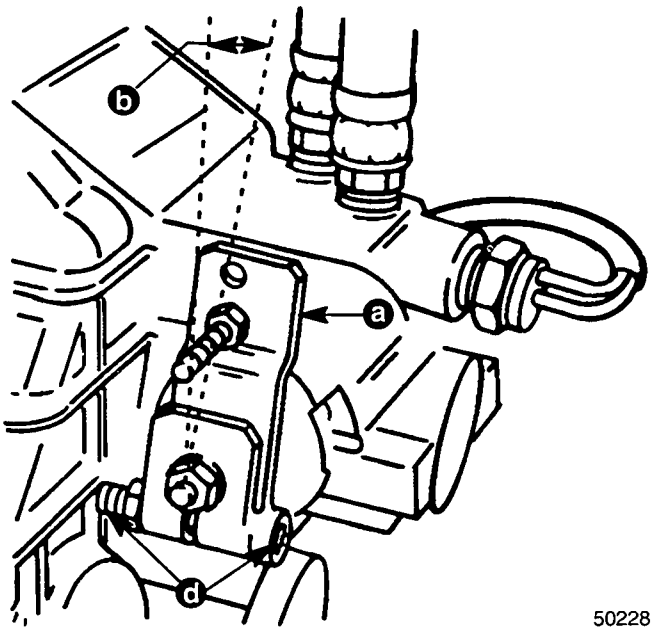
Late Style Shift Cable Bracket - Anchor Stud Position Shown For 800 Transmission

a - Bracket, Shift Cable
b - Shift Cable Anchor Stud
c - Bracket-to-Transmission Fasteners

IMPORTANT: Check that shift lever is positioned approximately 10° aft of vertical when in the neutral detent position and that the distance ("c") between studs in the following is set at 7-1/8 in. (318mm). If necessary, loosen clamping bolt and position lever so that dimension "c" is as shown when in the neutral detent position and retighten bolt.



50203



50228

a - Shift Lever
b - Lever, in Neutral Detent, Must Be Approximately 10 Degrees Aft of Vertical
c - Dimension Between Studs - 7-1/8 in. (318mm)
d - Clamping Bolt

Typical Hurth Transmission Shown

b. Place remote control shift lever, and transmission shift lever, in neutral position.

c. Remove nuts and washers from shift cable attaching studs.

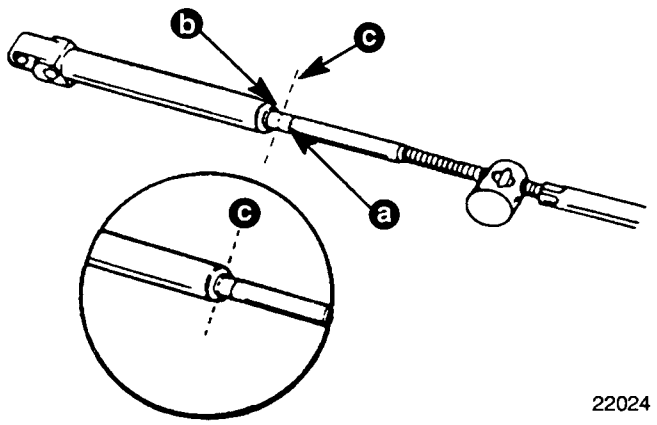
d. Locate center of remote control and control shift cable play (backlash), as follows:

(1) Check that remote control is in neutral position.

(2) Push in on control cable end with enough pressure to remove play, and mark position "a" on tube.

(3) Pull out on control cable end with enough effort to remove play, and mark position "b" on tube.

(4) Measure distance between marks "a" and "b", and mark position "c", half-way between marks "a" and "b".



22024

e. Center cable-end play, then adjust cable barrel to align holes in barrel and in cable end guide with attaching points on transmission.

f. Temporarily install shift cable. Do not secure at this time.

IMPORTANT: Transmission is "fully" in gear when shift lever comes to a stop, in either direction.

g. Place remote control shift lever in forward gear position. Check of ensure transmission is fully in gear, as follows:

(1) Hold shift lever in position.

(2) Carefully slide shift cable off of anchor points.

(3) Attempt to move shift lever further.

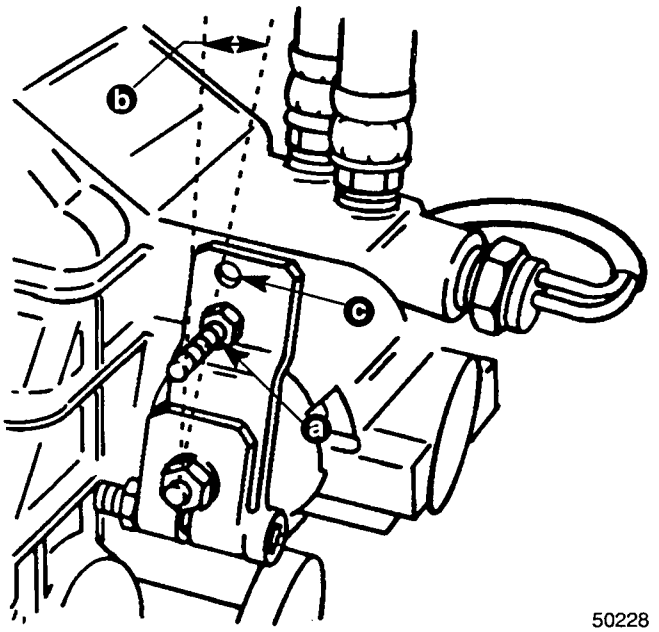
h. Place remote control shift lever in reverse gear position and again check to ensure transmission is fully in gear as follows:

(1) Hold shift lever in position.

(2) Carefully slide shift cable off of anchor points.

(3) Attempt to move shift lever further.

i. If transmission shift lever will position properly in one gear, but not in the other, recheck shift cable adjustment. If transmission shift lever will not position properly in both gears, move transmission shift lever stud (a), from top hole in shift lever, to bottom hole, and recheck for proper positioning . If proper positioning is still not obtained, remote control does not provide sufficient shift cable travel and must be replaced.



50228

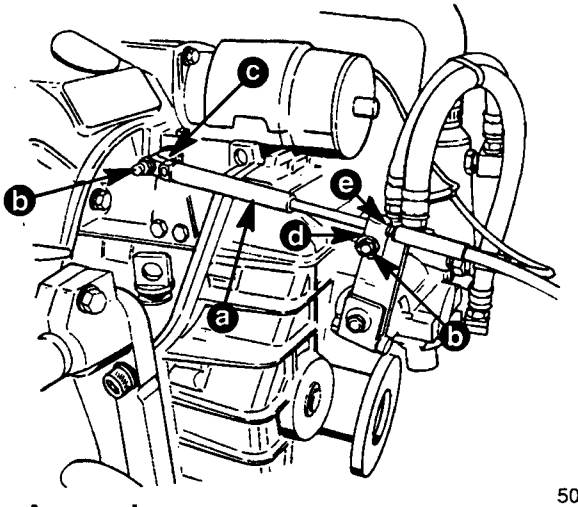
a - Shift Lever Stud (In Bottom Hole, If Required)
b - Lever, in Neutral Detent, Must Be Approximately 10 Degrees Aft of Vertical
c - Shift Lever Top Hole

Typical Hurth Transmission Shown

j. Install nut and washer to cable end guide stud. Tighten until snug, then back off one-full turn.

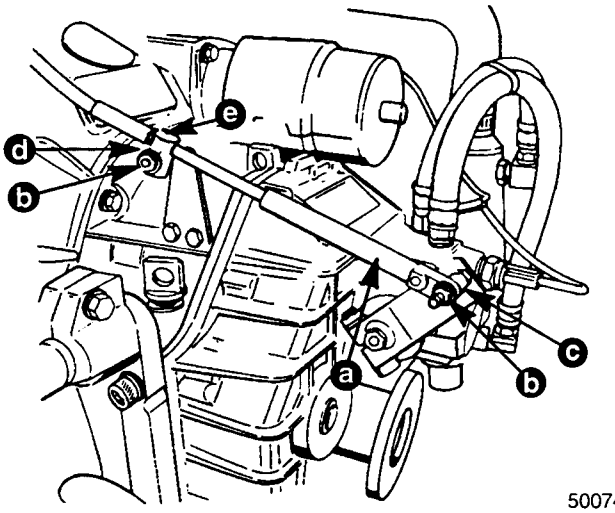
k. Install nut and washer to cable barrel stud. Tighten until they bottom out. Tighten securely, but do not over tighten.

SINGLE STATION INSTALLATIONS



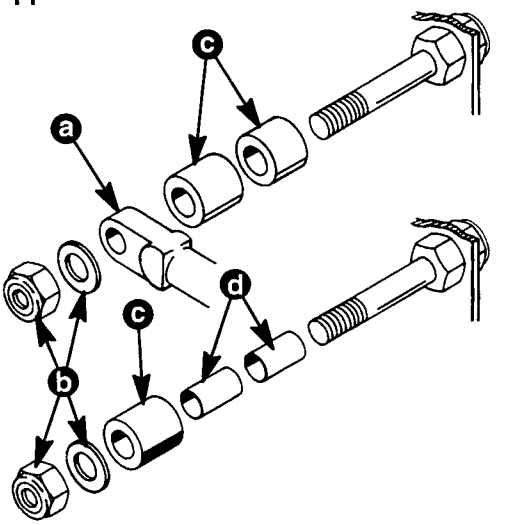
50074

Rear Approach



50074

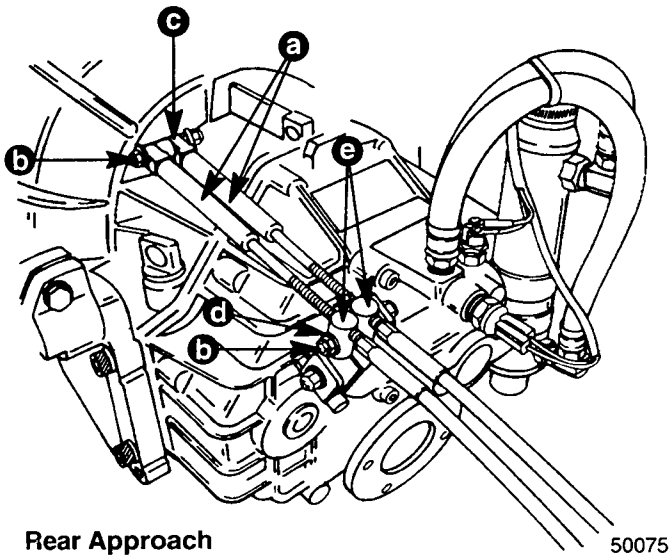
Front Approach



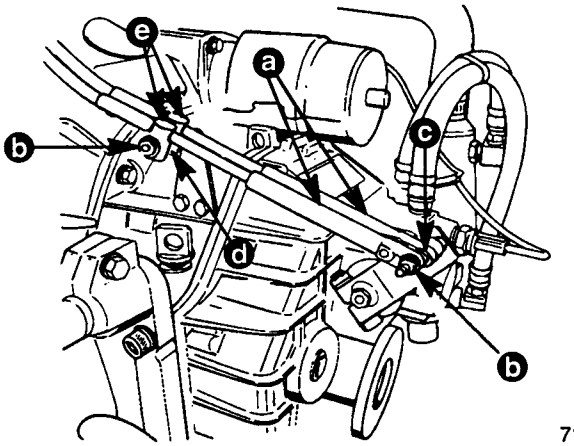
50229

a - Cable End Guide
b - Locknut and Washer
c - Spacer
d - Bushings
e - Cable Barrel

DUAL STATION INSTALLATIONS

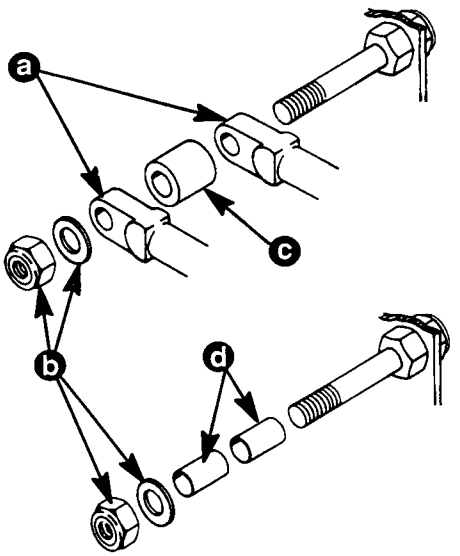


Rear Approach 50075



71179

Front Approach



a - Cable End Guide
b - Locknut and Washer
c - Spacer
d - Bushings
e - Cable Barrel

50073

NOTE: To change cable approach direction on single or dual station installations, only the spacers/bushings have to be switched to the opposite stud (the studs are identical).

6. Connect and adjust Quicksilver throttle cable(s) as outlined following:

IMPORTANT: When installing throttle cables, be sure that cables are routed in such a way as to avoid sharp bends and/or contact with moving parts. DO NOT fasten any items to throttle cables.

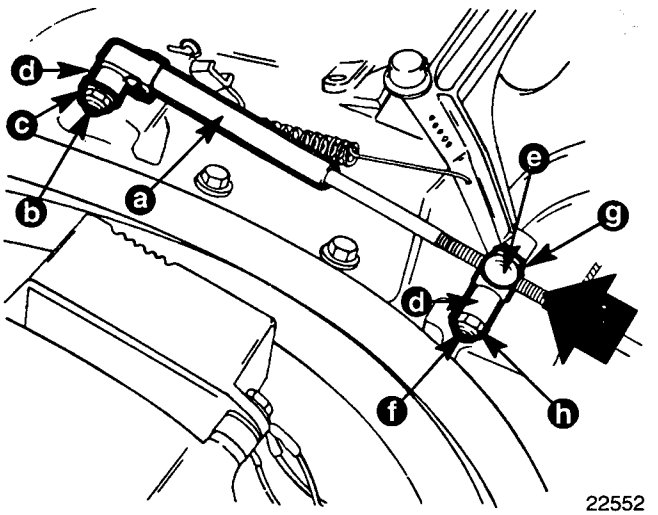
NOTE: On models equipped with other than Quicksilver throttle cables, attach and adjust throttle cables following cable manufacturer's instructions.

a. Place remote control throttle lever(s) in idle position.

b. Install cable end guide on carburetor throttle lever stud as shown. Push cable barrel lightly toward throttle lever (This will place a slight preload on cable to avoid slack in cable when moving remote control levers.). Then adjust cable barrel to align with anchor stud and slide barrel onto stud.

c. Secure throttle cable with hardware as shown. Tighten cable end guide locknut until it bottoms out and then back off 1 full turn. Tighten barrel locknut until secure, but DO NOT OVER TIGHTEN as cable(s) must be able to pivot.

SINGLE STATION

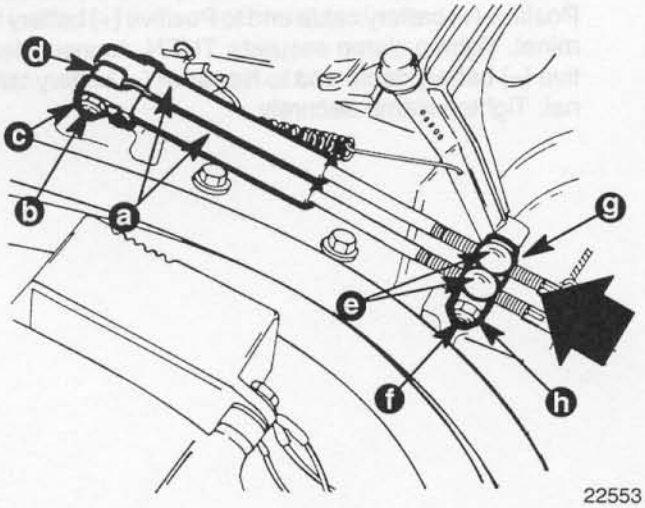


22552

Rochester or Weber Carburetor

a - Cable End Guide
b - Throttle Lever Stud
c - Washer and Locknut
d - Spacer
e - Cable Barrel
f - Anchor Stud
g - Washer
h - Washer and Locknut

DUAL STATION



22553

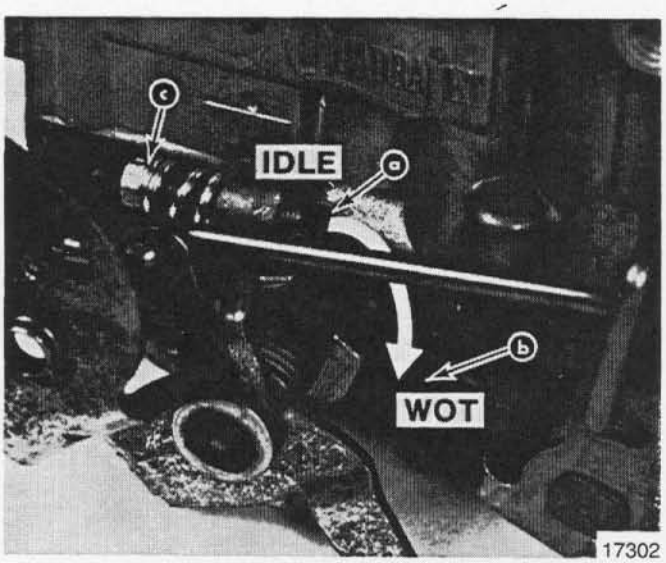
Rochester or Weber Carburetor

a - Cable End Guide
b - Throttle Lever Stud
c - Washer and Locknut
d - Spacer
e - Cable Barrel
f - Anchor Stud
g - Washer
h - Washer and Locknut

d. Place remote control throttle lever(s) in the wide-open-throttle (W.O.T.) position. Check to ensure that throttle shutters (valves) are completely open.

e. Return remote control throttle lever to idle position and check to ensure that throttle lever contacts idle speed adjustment screw.

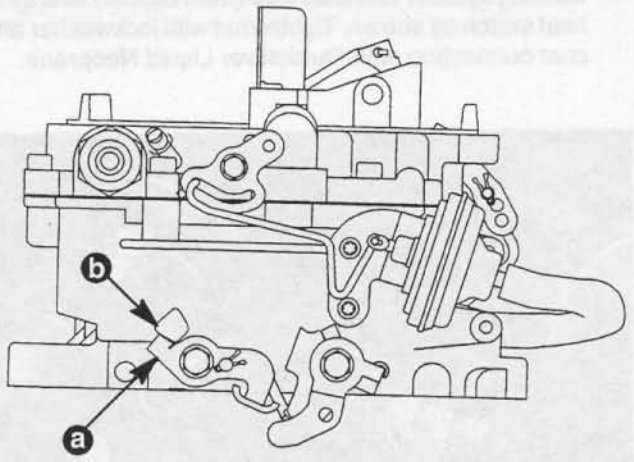
MODELS WITH ROCHESTER 4 BARREL CARBURETOR



17302

a - Tang
b - Carburetor Body
c - Idle RPM Adjustment Screw

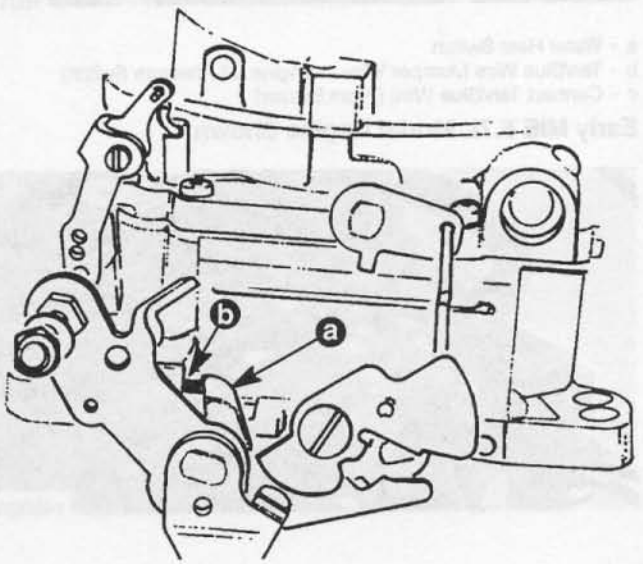
MODELS WITH WEBER 4 BARREL CARBURETOR



71159

a - Throttle Shaft Lever (Contacts "b" at W.O.T. Position)
b - Carburetor Body Casting

Wide-Open-Throttle Position Shown



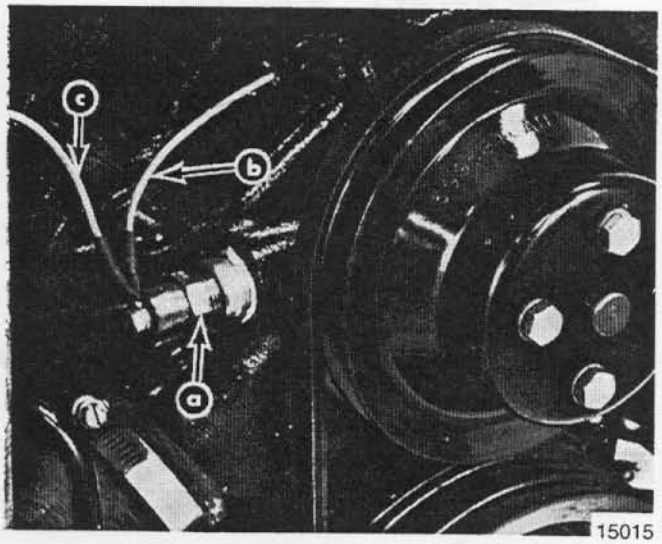
70392

a - Throttle Lever (Contacts "b" In Idle Position)
b - Idle Speed Adjustment Screw

Idle Position Shown

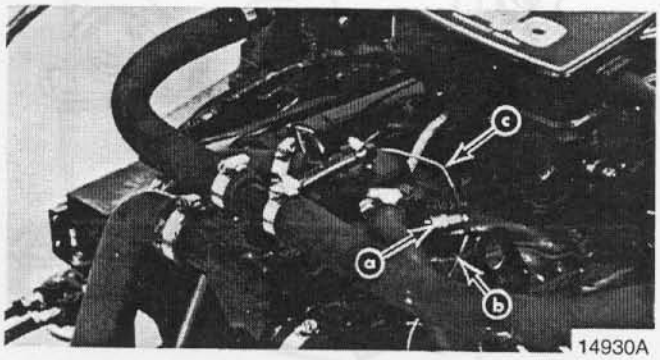
7. Connect any ground wires or accessories that may have been disconnected from engine.

8. If not part of main engine wiring harness, connect audio warning system Tan/Blue wire (from buzzer) at engine heat switch as shown. Tighten nut with lockwasher and ccat connection with Quicksilver Liquid Neoprene.



a - Water Heat Switch
b - Tan/Blue Wire (Jumper Wire to Engine Oil Pressure Switch)
c - Connect Tan/Blue Wire (From Buzzer)

Early MIE 5.7L Model Engine Shown



a - Water Heat Switch
b - Tan/Blue Wire (Jumper Wire to Engine Oil Pressure Switch)
c - Connect Tan/Blue Wire (From Buzzer)

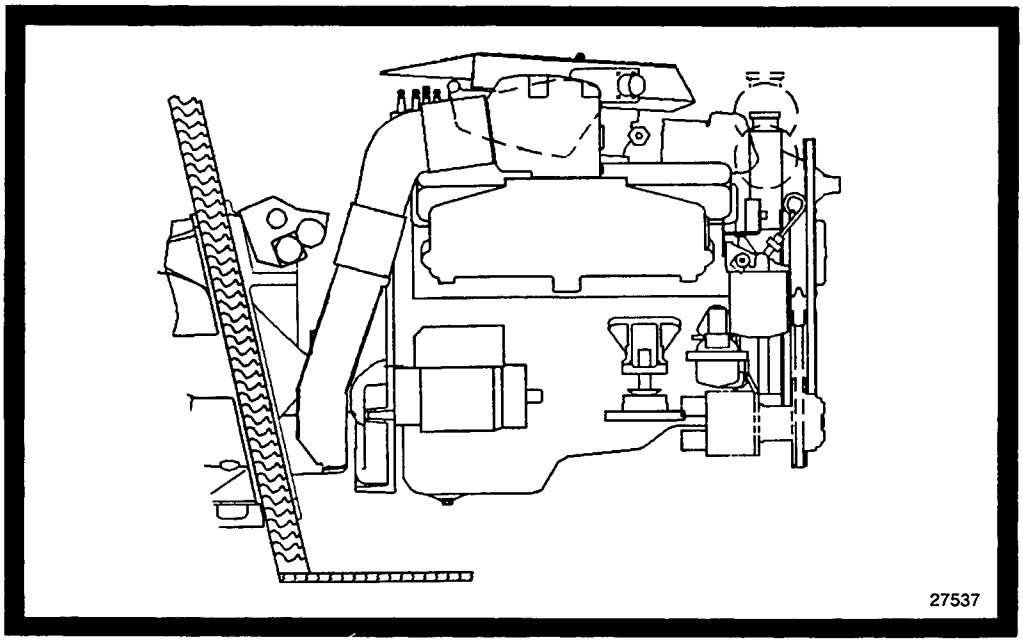
Early MIE 7.4L Model Engine Shown

9. Connect battery cables to battery by FIRST connecting Positive (+) battery cable end to Positive (+) battery terminal. Tighten clamp securely. THEN, connect Negative (–) battery cable end to Negative (–) battery terminal. Tighten clamp securely.

ENGINE

3

A



V-8 305/350 CID (5.0/5.7 LITRE)

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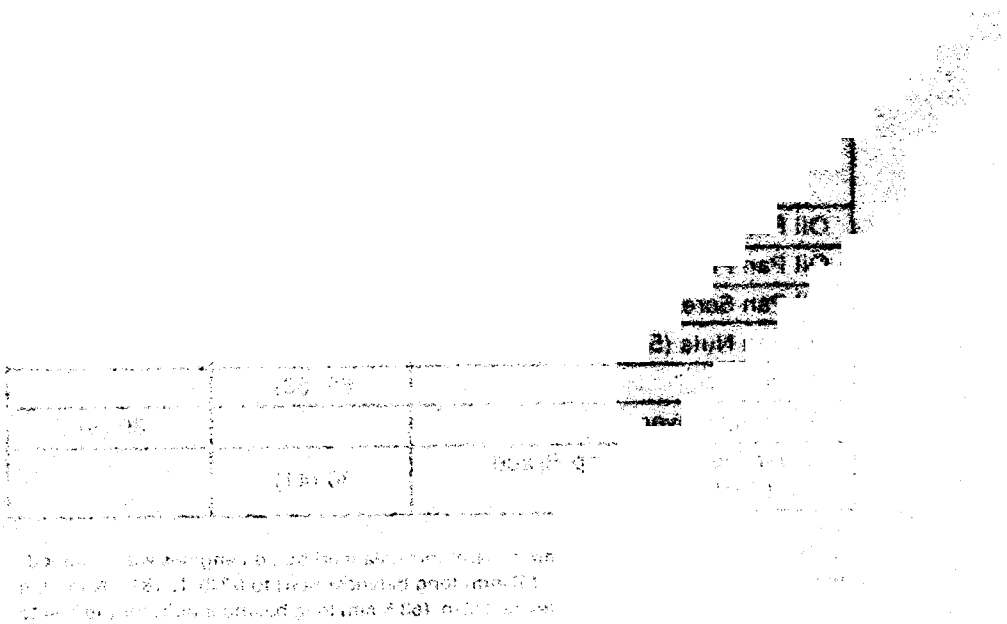
Torque Specifications 305/350 CID (5.0/5.7 Litre) Engines

Fastener Location	305/350 CID (5.0/5.7L)	
	Lb. Ft. (N·m)	Lb. In. (N·m)
Alternator Brace to Alternator		192 (28)
Alternator Brace to Block	30 (41)	
Alternator to Mounting Bracket	35 (48)	
Alternator Mounting Bracket	30 (41)	
Camshaft Sprocket/Gear	18 (24)	216 (24)
Roller Lifter Restrictor Retainer Plate		144 (16)
Carburetor		132 (15)
Connecting Rod Cap	45 (61)	
Coupler/Flywheel (MCM)	35 (48)	
Crankshaft Damper	See Note 1	
Crankshaft Pulley	35 (48)	
Cylinder Head	65 (88)	
Distributor Hold Down	25 (34)	
Exhaust Manifold	20 (27)	
Flywheel	75 (100)	
Flywheel Drive Plate (MIE)	35 (48)	
Flywheel Housing to Block	30 (41)	
Flywheel Housing Cover		80 (9)
Front Mount Bracket	30 (41)	
Fuel Pump	25 (34)	
Intake Manifold	35 (48)	
Main Bearing Cap	80 (109)	
Rear Crankshaft Oil Seal Retainer Screws & Nuts		135 (15)
Oil Filter Adaptor Bolts	15 (20)	
Oil Pan Plug	20 (27)	
Oil Pan Screw (1/4"-20)		100 (11)
Oil Pan Nuts (5/16"-18)	16 (22)	200 (22)
Oil Pump	65 (88)	
Oil Pump Cover		80 (9)
Power Steering Pump Brace to Block	30 (41)	

NOTE 1: Torque crankshaft damper (harmonic balancer) bolt on engines with stamped-steel crankshaft pulley [2-1/4 in. (57mm) long balancer bolt] to 60 lb. ft. (81.3 N·m). On engines with cast aluminum pulley [2-1/2 in. (63.5mm) long balancer bolt] torque bolt to 40 lb. ft. (54.2 N·m).

Fastener Location	305/350 CID (5.0/5.7L)	
	Lb. Ft. (N·m)	Lb. In. (N·m)
Power Steering Pump Bracket	30 (41)	
Rear Mount (MCM)	40 (54)	
Rear Mount (MIE)	50 (68)	
Remote Oil (1/2"-13)	25 (34)	
Filter Adaptor (5/16"-18)	20 (27)	
Rocker Arm Cover		90 (10)
Seawater Pump Brace	30 (41)	
Seawater Pump Bracket	30 (41)	
Spark Plugs	15 (20)	180 (20)
Starter Motor	50 (68)	
Thermostat Housing	30 (41)	
Timing Chain or Gear Cover		100 (11)
Transmission to Housing	50 (68)	
Water Circulating Pump	30 (41)	
Water Temp. Sender	20 (27)	
Oil Baffle Nuts	25 (34)	
Remote Oil Filter Adaptor Cover	15 (20)	180 (20)



Tools/Lubricants/Sealants

MERCURY MARINE SPECIAL TOOLS	
91-24697	Piston Ring Expanders
91-35547	Engine Coupler Wrench
91-66273	Rocker Stoppers

KENT-MOORE SPECIAL TOOLS

Can be ordered from: Kent-Moore Tools, Inc.
29784 Little Mack
Roseville, MI 48066
Phone: (313) 574-2332

J5892	Valve Spring Compressor
J8062	Valve Spring Compressor
J8056	Valve Spring Tester
J8101	Valve Guide Cleaner
J5830-2	Valve Guide Reamer
J7049	Valve Guide Reamer
J5802-01	Rocker Arm Stud Remover
J6880	Rocker Arm Stud Installer
J5715	Rocker Arm Stud Hole Reamer (.003" O.S.)
J6036	Rocker Arm Stud Hole Reamer (.013" O.S.)
J8089	Carbon Remover Brush
J24086-B	Piston Pin Tool
J3936-03	Piston Ring Groove Cleaner
J8037	Piston Ring Compressor
J5239	Connecting Rod Bolt Guide Set (3/8-24)
J21882	Oil Pump Suction Pipe Installer
J6098-01	Camshaft Bearing Remover and Installer Tool
J23523-E	Harmonic Balancer Removal and Installer Tool
J35468	Crankcase Front Cover Seal Installer
J5825-A	Crankshaft Gear and Sprocket Puller
J5590	Crankshaft Gear and Sprocket Installer
J23590	Air Adaptor
J8080	Main Bearing Remover/Installer
J26817	Rear Main Seal Installer

LUBRICANTS/SEALANTS	
92-32609-1	Quicksilver Loctite
92-34227	Quicksilver Perfect Seal
92-42649A1	Quicksilver Needle Bearing Assembly Lubricant
92-91601-1	Quicksilver RTV Sealer

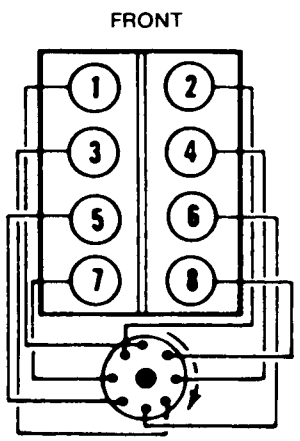
LUBRICANT OBTAINED LOCALLY
General Motors Engine Oil Supplement or its equivalent

Engine Specifications

UNIT OF MEASUREMENT in. (mm)

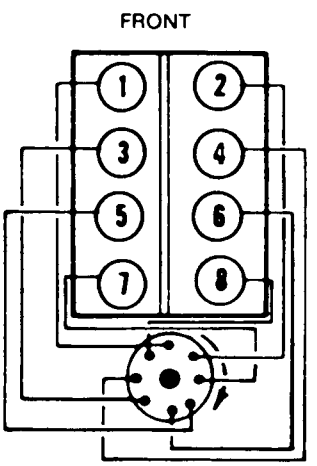
ENGINE MODEL	MCM 5.0 LITRE	MCM 5.0 LITRE	MIE 5.0 LITRE	MCM 5.7 ALPHA	MCM 5.7 BRAVO	MIE 5.7 LITRE	MIE 5.7 COMPETI-TION SKI	MCM 350 MAGNUM ALPHA	MIE 350 MAGNUM TOURNAMENT SKI
Displacement	305 CID (5.0 Litre)			350 CID (5.7 Litre)					
Bore	3.74 (95)			4.00 (101.6)					
Stroke	3.48 (88.4)			3.48 (88.4)					
Compression Ratio	9.3:1								
Heads	Cast Iron								
Intake Manifold	Cast Iron (Magnum — High Rise)								
Block	Cast Iron (2 Bolt Main Bearing Caps)								
Rods	Forged Steel								
Pistons	Cast Aluminum								
Crankshaft	Cast Iron								
Camshaft	Cast Iron			Cast Iron Steel (Note)		Cast Iron		Cast Iron Steel (Note)	Steel (Note)
Fuel Pump Push Rod	Steel			Steel Cast Iron (Note)		Steel		Steel Cast Iron (Note)	Cast Iron (Note)

NOTE: Engines with roller lifters and matching camshaft; Engine Block Code "CD." See Engine Block Code Information.



Firing Order
1-8-4-3-6-5-7-2

Left-Hand (Standard) Rotation Engine



Firing Order
1-2-7-5-6-3-4-8

Right-Hand (Opposite) Rotation Engine

Engine				305 CID (5.0 LITRE)	350 CID (5.7 LITRE)
Cylinder Bore:					
Diameter				3.7350 - 3.7385 (94.8690 - 94.9579)	3.9995 - 4.0025 (101.5873 - 101.6635)
Out of Round		Production		.001 (0.025) Max.	
		Service		.002 (0.05) Max.	
Taper	Production		Thrust Side	.0005 (0.0127) Max.	
			Relief Side	.001 (0.025) Max.	
	Service			.001 (0.025) Max.	
Piston:					
Clearance		Production		.0007 - .0017 (0.0178 - 0.0432)	
		Service		.0027 (0.07) Max.	
Piston Ring:					
Compression	Groove Side Clearance	Production	Top	.0012 - .0032 (0.0305 - 0.0813)	
			2nd	.0012 - .0032 (0.0305 - 0.0813)	
		Service		Hi-Limit Production + .001 (0.025)	
	Gap	Production	Top	.010 - .020 (0.25 - 0.5)	
			2nd	.010 - .025 (0.25 - 0.6)	
		Service		Hi-Limit Production + .010 (0.25)	
Oil	Groove Side Clearance	Production		.002 - .007 (0.05 - 0.15)	
		Service		Hi-Limit Production + .001 (0.025)	
	Gap	Production		.015 - .055 (0.35 - 1.35)	
		Service		Hi-Limit Production + .010 (0.25)	
Piston Pin:					
Diameter				.9269 - .9271 (23.5458 - 23.5534)	
Clearance in Piston		Production		.0002 - .0007 (0.0050 - 0.0177)	
		Service		.001 (0.02) Max.	
Fit in Rod				.0008 - .0016 (0.0203 - 0.0406) Interference	

Engine			305 CID (5.0 LITRE)	350 CID (5.7 LITRE)
Crankshaft:				
Main Journal	Diameter	No. 1	2.4484 - 2.4493 (62.1894 - 62.2122)	
		No. 2, 3, 4	2.4481 - 2.4490 (62.1817 - 62.2046)	
		No. 5	2.4479 - 2.4488 (62.1767 - 62.1995)	
	Taper	Production	.0002 (0.0051) Max.	
		Service	.001 (0.025) Max.	
	Out of Round	Production	.0002 (0.0051) Max.	
		Service	.001 (0.025) Max.	
Main Bearing Clearance	Production	No. 1	.0008 - .0020 (0.0203 - 0.0508)	
		No. 2, 3, 4	.0011 - .0023 (0.0279 - 0.0584)	
		No. 5	.0017 - .0032 (0.0432 - 0.0813)	
	Service	No. 1	.0010 - .0015 (0.0254 - 0.0381)	
		No. 2, 3, 4	.0010 - .0025 (0.0254 - 0.0635)	
		No. 5	.0025 - .0035 (0.0635 - 0.0889)	
Crankshaft End Play			.002 - .006 (0.051 - 0.152)	
Connecting Rod Journal	Diameter		2.0988 - 2.0998 (53.3095 - 53.3349)	
	Taper	Production	.0005 (0.0127) Max.	
		Service	.001 (0.025) Max.	
	Out of Round	Production	.0005 (0.0127) Max.	
		Service	.001 (0.025) Max.	
Rod Bearing Clearance		Production	.0013 - .0035 (0.0330 - 0.0889)	
		Service	.003 (0.076) Max.	
Rod Side Clearance			.006 - .014 (0.152 - 0.356)	
Crankshaft Runout			.0015 (0.0381) Max.	

Engine			305 CID (5.0 LITRE)	350 CID (5.7 LITRE)

Valve System:

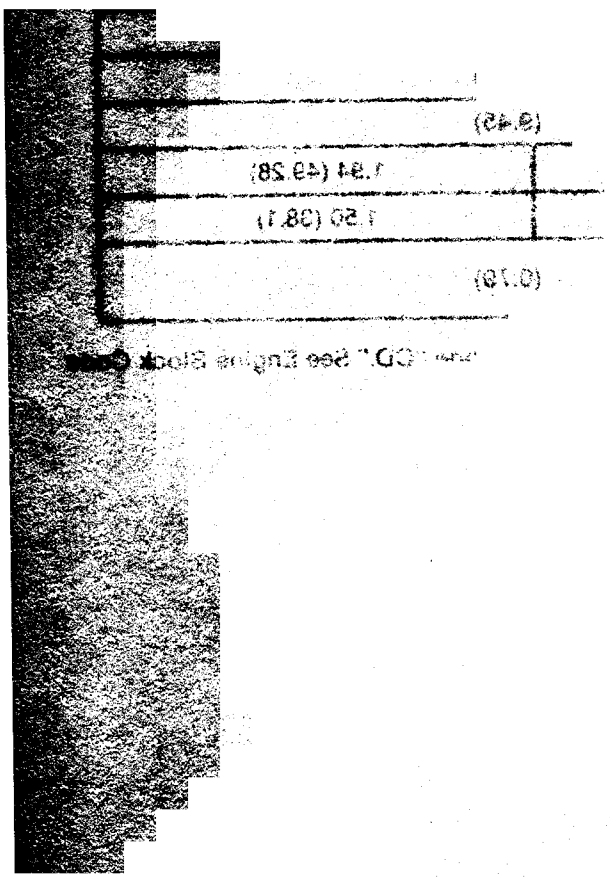
Lifter Type			Flat Hydraulic	Flat Hydraulic Roller Hydraulic (Note 1)
Rocker Arm Ratio			1.50 to 1	
Valve Lift	Intake		.394 (10.00)	
	Exhaust		.404 (10.26)	
Valve Lash (Intake & Exhaust)			1 Turn Down from Zero Lash	
Face Angle (Intake & Exhaust)			45°	
Seat Angle (Intake & Exhaust)			46°	
Seat Runout (Intake & Exhaust)			.002 (.051) Max.	
Seat Width	Intake		1/32 - 1/16 (0.794 - 1.587)	
	Exhaust		1/16 - 3/32 (1.587 - 2.381)	
Stem Clearance	Production	Intake	.0010 - .0027 (0.0254 - 0.0686)	
		Exhaust	.0010 - .0027 (0.0254 - 0.0686)	
	Service	Intake	.0037 (0.0940)	
		Exhaust	.0047 (0.1194)	
Stem Diameter		Intake	.341 (8.66)	
		Exhaust	.372 (9.45)	
Valve Diameter		Intake	1.84 (46.74)	1.94 (49.28)
		Exhaust	1.50 (38.1)	1.50 (38.1)
Valve Margin Intake and Exhaust			1/32 (0.79)	

NOTE 1: Engines with roller lifters and matching camshaft; Engine Block Code "CD." See Engine Block Code Information.

Engine			305 CID (5.0 LITRE)	350 CID (5.7 LITRE)
Valve Spring:				
Valve Spring (Note 2)	Spring 24-48347 Lavender Stripe	Free Length		2.03 [2-1/32] (51.6) (Note 1)
		Pressure	Closed at 1.70 [1-45/64] (43.16)	76-84 lbs. (338-374 N) (Note 1)
			Open at 1.25 [1-1/4] (31.75)	194-206 lbs. (862-916 N) (Note 1)
		Installed Height		1.70 [1-45/64] (43)
Damper	Free Length			1.86 [1-55/64] (47.24)
	Approximate Number of Coils			4

NOTE 1: Including engines with roller lifters and matching camshaft; Engine Block Code "CD." See Engine Block Code Information.

NOTE 2: Test spring pressure with damper removed.



Engine		305 CID (5.0 LITRE)	350 CID (5.7 LITRE)
Camshaft and Drive:			
Lobe Lift ± .002 (0.051)	Intake	.263 (6.680)	.263 (6.680)
			.287 (7.29) (Note)
	Exhaust	.269 (6.833)	.269 (6.833)
			.300 (7.62) (Note)
Duration at .050 in. (1.27mm) Cam Lift	Intake	269°	269°
			196° (Note)
	Exhaust	283°	283°
			207° (Note)
Journal Diameter		1.8682 - 1.8692 (47.452 - 47.478)	
Journal Out-of-Round		.001 (0.025) Max.	
Camshaft Runout		.002 (0.051) Max.	
Timing Chain Deflection [L.H. (Standard) Rotation Engines Only]		3/8 (10) from Taut Position [3/4 (19) Total]	
Camshaft Timing Gear Runout [R.H. (Opposite) Rotation Engines Only]		.004 (0.102) Max.	
Crankshaft Timing Gear Runout [R.H. (Opposite) Rotation Engines Only]		.003 (0.076) Max.	
Camshaft to Crankshaft Timing Gear Backlash [R.H. (Opposite) Rotation Engines Only]		.004 - .006 (0.102 - 0.152) New Gears .004 - .008 (0.102 - 0.203) Used Gears	
Flywheel:			
Runout		.008 (0.203) Max.	
Cylinder Head:			
Gasket Surface Flatness		.007 (0.15) Overall Maximum .003 (0.07) Within A 6 in. (152mm) Span	

NOTE: Engines with roller lifters and matching camshaft; Engine Block Code "CD." See Engine Block Code Information.

General

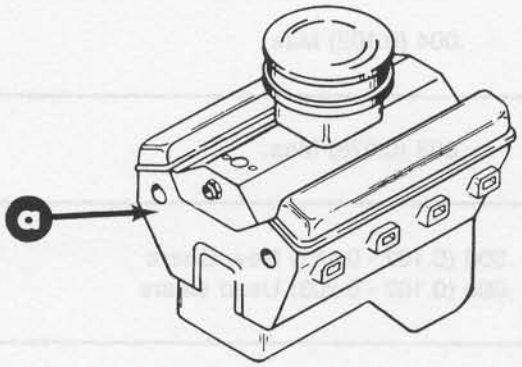
Some repairs, that are listed in this section, must be completed with engine removed from boat. Engine removal depends upon type of repair and boat design. Place engine on repair stand for major repairs.

Lubricate all moving parts (during reassembly) with engine oil. Apply Perfect Seal on threads of and under head of cylinder head bolts and on threads of all cylinder block external bolts, screws and studs.

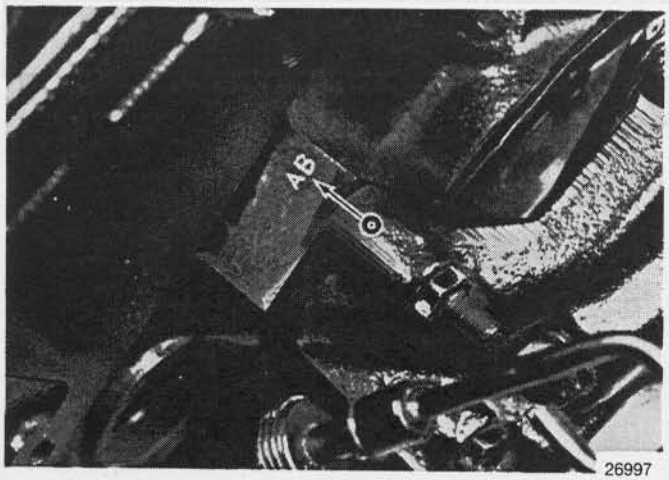
Engine Identification

The MerCruiser Model can be determined by looking at the last two letters of the engine code stamped into the cylinder block. This code number is stamped on all MerCruiser Power Packages and replacement partial engines but not replacement cylinder block assemblies.

If the engine serial number, and or model decals are missing, the engine code letters may help in determining the engine models. Following is a list of G.M. engines and their respective code letters.



a - Location of GM engine code for 5.0/5.7 Litre (305/350 CID) engines



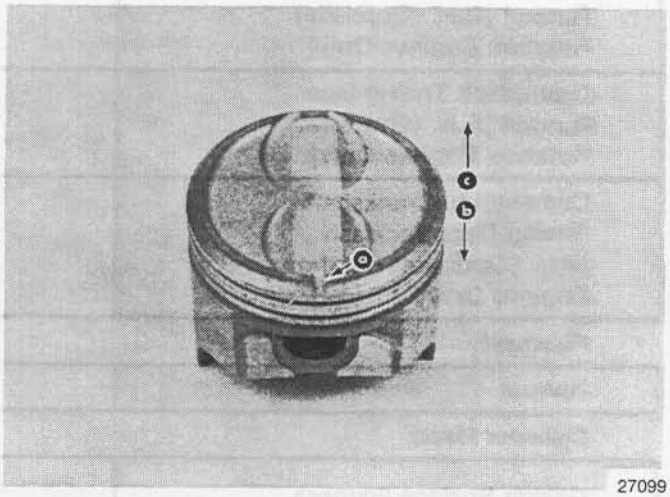
a - Engine Code "AB"

MCM	CODE	ROTATION
5.0 Litre	PC, ZC	LH
5.0 Litre LX	PD, ZD	
5.7 Litre	AB, MB	
350 Magnum	AS, MS	
5.7 Litre (Note)	CD, (Note)	
350 Magnum (Note)	CD, (Note)	

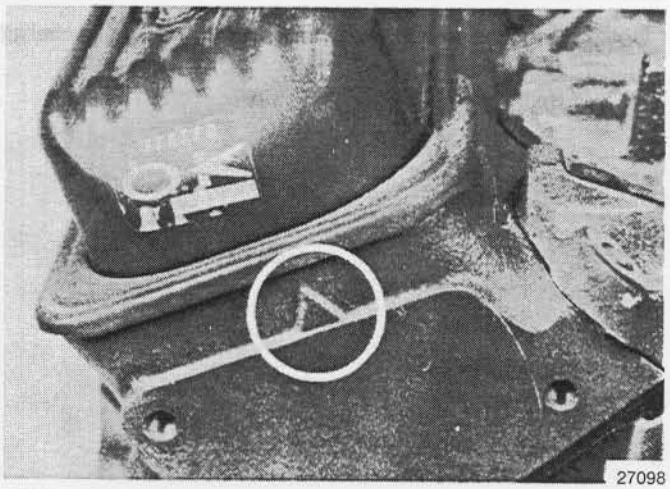
MCM	CODE	ROTATION
5.0 Litre	PF	LH
5.0 Litre	PH	RH
5.7 Litre	AN, MN	LH
5.7 Litre 5.7 Competition Ski	AR, MR AB, MB	RH LH
5.7 Competition Ski	AR, MR	RH
350 Magnum Tournament Ski (Note)	CD (Note)	LH

NOTE: Engines with roller lifters and matching camshaft.

Cylinder head code location



5.0 litre/305 CID



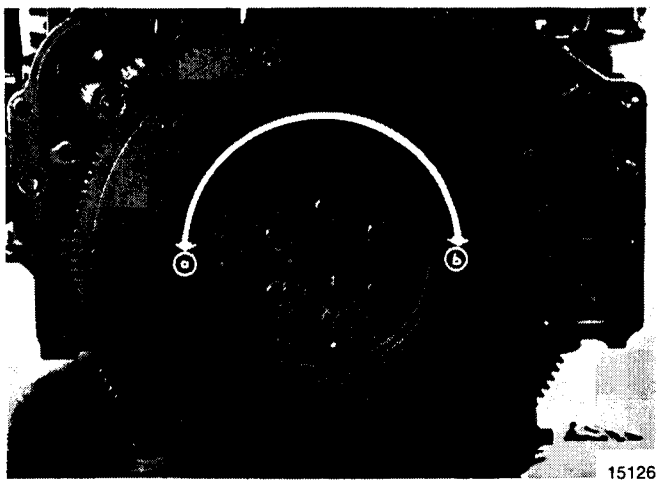
5.7 litre/350 CID

Engine Rotation

Engine rotation terminology at times has caused confusion. To clarify, engine rotation is determined by observing flywheel rotation from the rear (transmission or stern drive end) of the engine looking forward (water pump end).

PROPELLER ROTATION IS NOT NECESSARILY THE SAME as engine rotation.

When ordering replacement engines, short blocks or parts for engines, be certain to check engine rotation. Do not rely on propeller rotation in determining engine rotation.



a - Left Hand Rotation (CCW) - All Stern Drive Engines, MIE Inboard L.H. (Standard) Rotation
b - Right Hand Rotation (CW) - MIE inboard R.H. (Opposite) Rotation

Crankshaft

The crankshaft is supported in the block by five insert type bearings. Crankshaft end thrust is controlled by flanges on the number five bearing. A torsional damper on the forward end of the crankshaft serves to help dampen any engine torsional vibration.

Piston and Connecting Rods

Piston pins are offset slightly toward the thrust side of the pistons to provide a gradual change in thrust pressure against the cylinder wall as the piston travels its path. Pins have a floating fit in the piston and a press fit in the connecting rod (to hold them in place).

Connecting rods are made of forged steel and are connected to the crankshaft thru insert type bearings.

Camshaft and Drive

Camshafts are generally made of cast iron, except on engines with roller lifters which have camshafts made of **steel.** All camshafts are driven at one-half crankshaft speed by a timing chain and sprockets, or by timing gears, and are supported by five main bearings, which are pressed into the block.

A helical gear on the aft end of the camshaft drives the distributor and oil pump, while an eccentric cam on the front of the camshaft actuates the fuel pump through a push rod. The fuel pump push rod is made of different material when used on engines with **steel** camshafts and roller lifters, than for engines with cast iron camshafts.

⚠CAUTION

Avoid rapid and severe camshaft and fuel pump push rod wear which could result in engine damage. Always use the fuel pump push rod specified for use with the steel camshaft in your engine.

On engines with flat faced lifters a taper on the lobes coupled with spherical foot of hydraulic valve lifters, causes the valve lifters to rotate, thus reducing wear. However, on engines with roller lifters, eight restrictors, held in place by a retaining plate, hold the hydraulic valve lifters from rotating so that they follow the cam lobes precisely.

Cylinder Head

The cylinder heads are made of cast iron and have individual intake and exhaust ports for each cylinder.

Stainless steel or graphite composition head gaskets are used to retard corrosion.

Valve Train

The valves and valve springs are of a heavy-duty design to withstand the high engine speeds encountered. Valve tips have been hardened to extend valve life. Exhaust valve rotators are used on some engines to help extend valve life.

Hydraulic valve lifters ride directly on the camshaft lobes and transmit the thrust of the lobes to the push rods which in turn actuate the valves thru the rocker arm.

In addition to transmitting thrust of the cam lobes, the hydraulic lifters also serves to remove any clearance (lash) from the valve train to keep all parts in constant contact.

The valve lifters also are used to lubricate the valve train bearing surfaces.

Intake Manifold

The manifold is of the double level design for efficient fuel distribution. The upper level of passages feeds cylinders 2, 3, 5 and 8 while the lower level passages feed cylinders 1, 4, 6 and 7. All passages are of approximately equal length to assure more even fuel-air mixture to the cylinders.

Lubrication System

The engine lubrication system is of the force-feed type in which oil is supplied under full pressure to the crankshaft, connecting rods, camshaft bearings and valve lifters, and is supplied under controlled volume to the push rods and rocker arms. All other moving parts are lubricated by gravity flow or splash.

A positive displacement gear-type oil pump is mounted on the rear main bearing cap and is driven by an extension shaft from the distributor (which is driven by the camshaft). Oil from the bottom of the pump in the rear of the oil pan is drawn into the oil pump through an oil pickup screen and pipe assembly.

If screen should become clogged, a relief valve in the screen will open and continue to allow oil to be drawn into system. Once the oil reaches the pump, the pump forces the oil thru the lubrication system. A spring loaded relief valve in the pump limits the maximum pump output pressure.

After leaving the pump, the pressurized oil flows thru a full-flow oil filter. On engines with an engine oil cooler, the oil also flows thru the cooler before returning to the block. A bypass valve allows oil to bypass the filter and oil cooler should they become restricted.

On 305 and 350 CID engines, some of the oil, after leaving the oil cooler and/or filter, is routed to the No. 5 crankshaft main bearing. The remainder of the oil is routed to the main oil gallery, which is located directly above the camshaft and runs the entire length of the block. From the main oil gallery, the oil is routed thru individual oil passages to an annular groove in each camshaft bearing bore. Some of the oil is then used to lubricate camshaft bearings. The remainder of the oil is routed to the valve lifter oil galleries and No. 1, 2, 3, and 4 crankshaft main bearings by means of individual oil passages which intersect with the annular grooves.

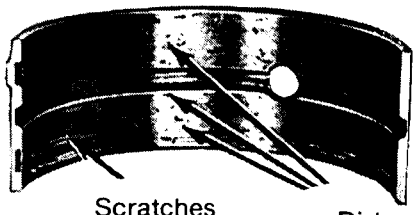
The camshaft bearings have holes which align with the oil passages or annular grooves in the block and allow oil to flow in between the bearings and the camshaft journals. The oil that is forced out the front end of the No. 1 camshaft bearing drains down onto camshaft drive and keeps it lubricated.

The oil which reaches the crankshaft main bearings is forced thru a hole in the upper half of each bearing and flows in-between the bearings and the crankshaft journals. Some of the oil is then routed to the connecting rod bearings thru grooves in the upper half of the crankshaft main bearings and oil passages in crankshaft. Oil which is forced out the ends of the connecting rod bearings and crankshaft main bearings is splashed onto the camshaft, cylinder walls, pistons and piston pins, keeping them lubricated. Oil which is forced out the front end of the No. 1 crankshaft main bearing also assists in lubricating the camshaft drive. A baffle plate, mounted on the bottom of the main bearings or in the oil pan, prevents oil thrown from the crankshaft and connecting rods from areating the oil in the oil pan.

Oil which reaches the valve lifters oil galleries is forced into each hydraulic valve lifter thru holes in the side of the lifter. From here, the oil is forced thru the metering valve in each of the lifters (which controls the volume of oil flow) and then up thru the push rods to the rocker arms. A hole in each rocker arm push rod seat allows the oil to pass thru the rocker arm and lubricate the valve train bearing surfaces. After lubricating valve train, oil drains back to the oil pan thru oil return holes in the cylinder head and block.

The distributor shaft and gear also is lubricated by the oil flowing thru the right valve lifter oil gallery. Fuel pump push rod is lubricated by oil thrown off from the camshaft eccentric.

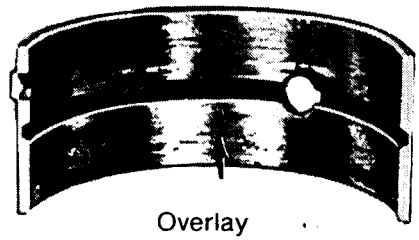
Bearing Failures



Scratches

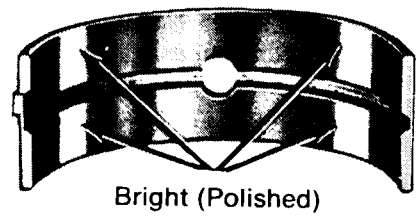
Dirt Imbedded into Bearing Material

SCRATCHED BY DIRT



Overlay Wiped Out

LACK OF OIL

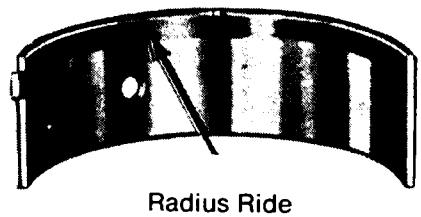


Bright (Polished) Sections

IMPROPER SEATING

Overlay Gone from Entire Surface

TAPERED JOURNAL



Radius Ride

RADIUS RIDE

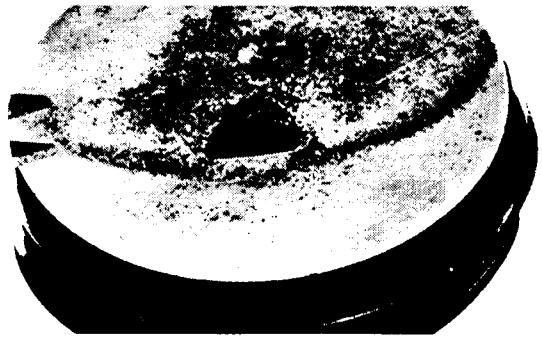
Craters or Pockets

FATIGUE FAILURE

Piston Failures

Pre-Ignition

Pre-ignition is abnormal fuel ignition, caused by combustion chamber hot spots. Control of the start of ignition is lost, as combustion pressure rises too early, causing power loss and rough running. The upward motion of the piston is opposed by the pressure rise. This can result in extensive damage to the internal parts from the high increase in combustion chamber temperature.

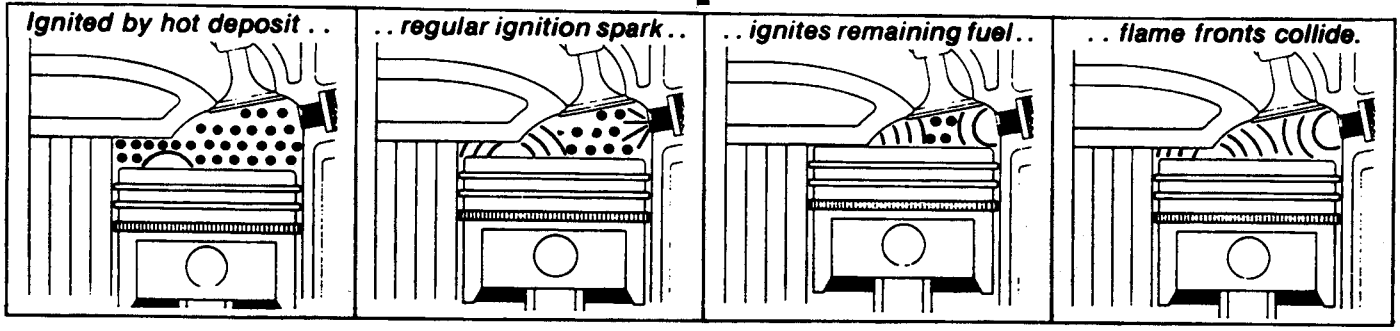


Pre-Ignition Damage

PRE-IGNITION CAUSES

1. Hot spots in the combustion chamber from glowing deposits (due in turn to the use of improper oils and/or fuels).
2. Overheated spark plug electrodes (improper heat range or defective plug).
3. Any other protuberance in the combustion chamber, such as an overhanging piece of gasket, an improperly seated valve or any other inadequately cooled section of material which can serve as a source.

Engine failures, which result from the foregoing conditions, are beyond the control of Mercury Marine, therefore, no warranty will apply to failures which occur under these conditions.



Detonation

Detonation, commonly called "fuel knock", "spark knock" or "carbon knock", is abnormal combustion of the fuel which causes the fuel to explode violently. The explosion, in turn, causes overheating or damage to the spark plugs, pistons, valves and, in severe cases, results in pre-ignition.

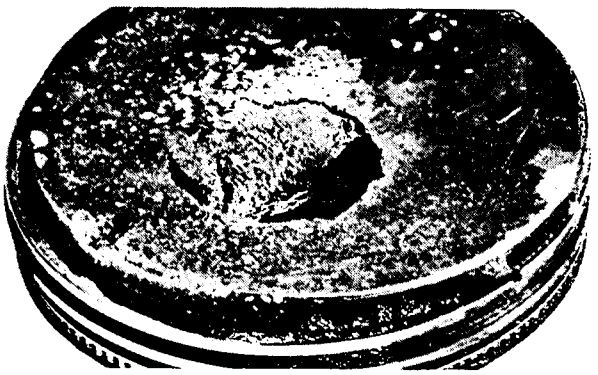
Use of low octane gasoline is one of the most common causes of detonation. Even with high octane gasoline, detonation could occur if engine maintenance is neglected.

OTHER CAUSES of DETONATION

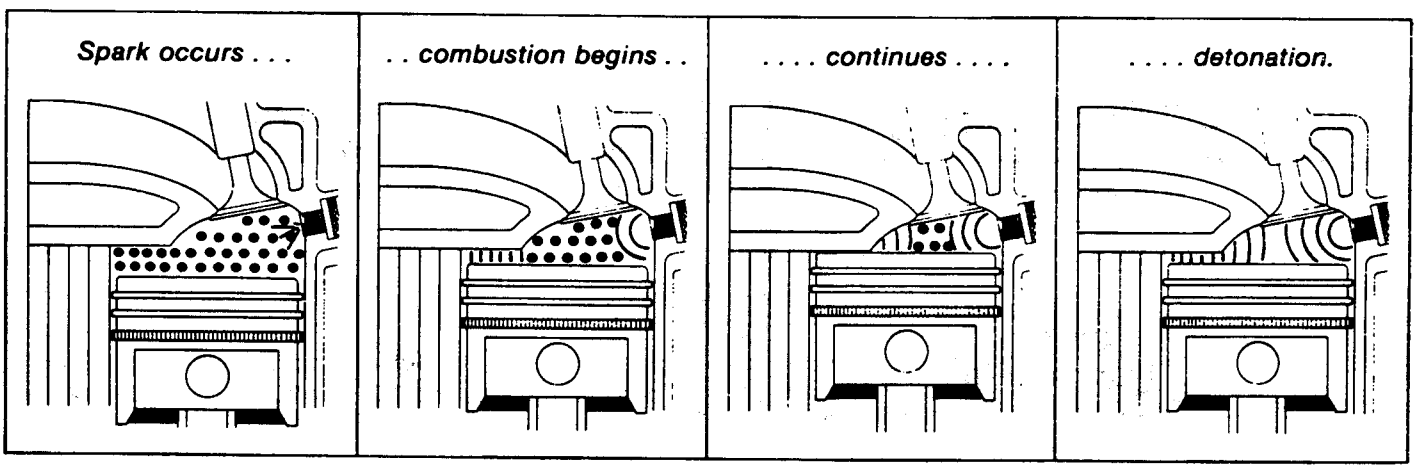
IMPORTANT: Use of improper fuels will cause engine damage and poor performance.

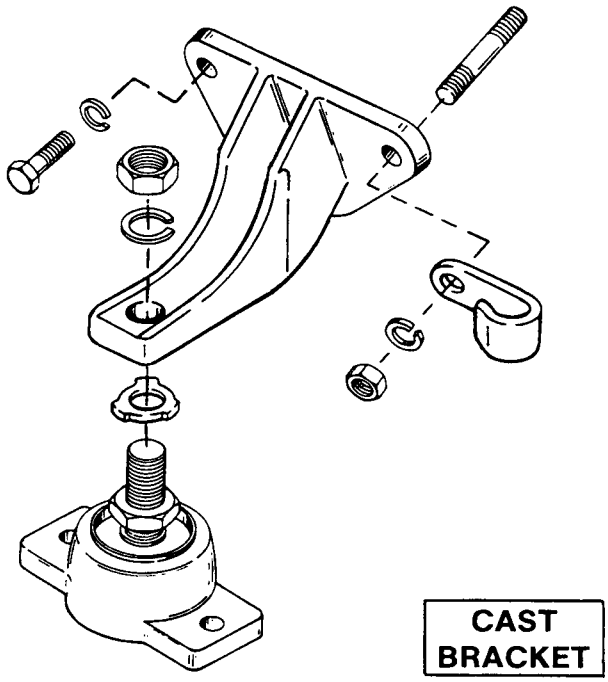
1. Over-advanced ignition timing.
2. Lean fuel mixture at or near full throttle (could be caused by carburetor or leaking intake manifold).
3. Cross-firing spark plugs.
4. Excess accumulation of deposits on piston and/or combustion chamber (results in higher compression ratio).
5. Inadequate cooling of engine by deterioration of cooling system.

Engine failures, which result from the foregoing conditions, are beyond the control of Mercury Marine, therefore, no warranty will apply to failures which occur under these conditions.

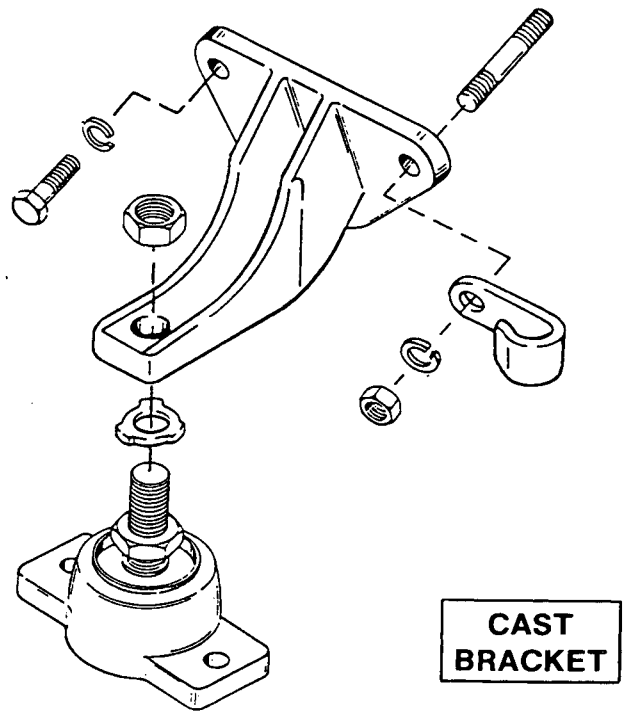


Detonation Damage

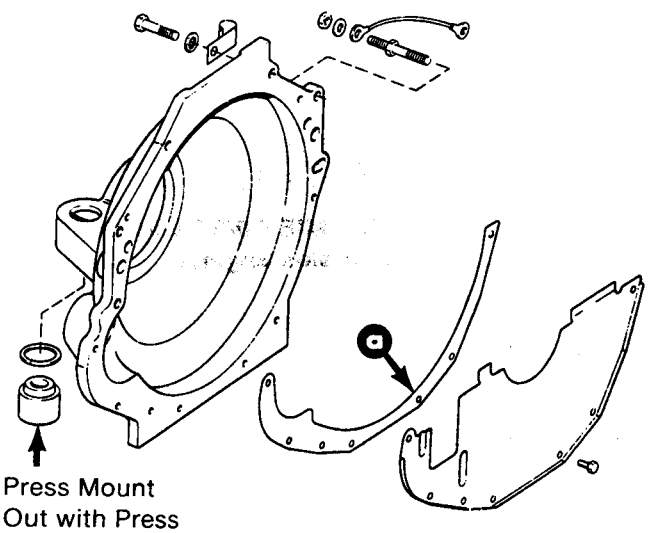




FRONT MOUNT - MCM 5.0/5.7 Litre (305/350 CID) Engines

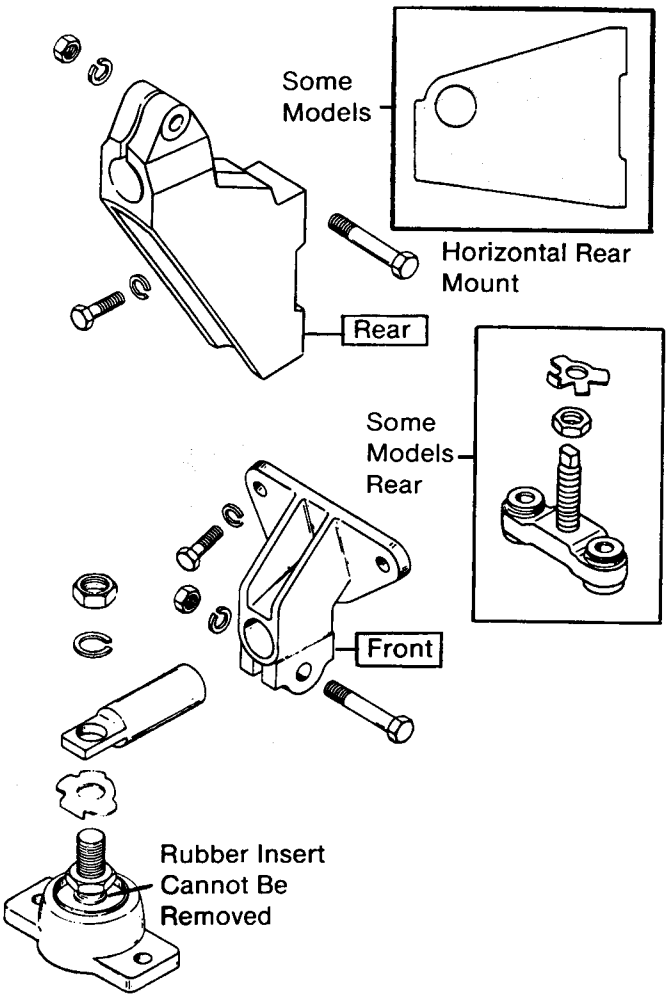


FRONT MOUNT - MCM 350 Magnum

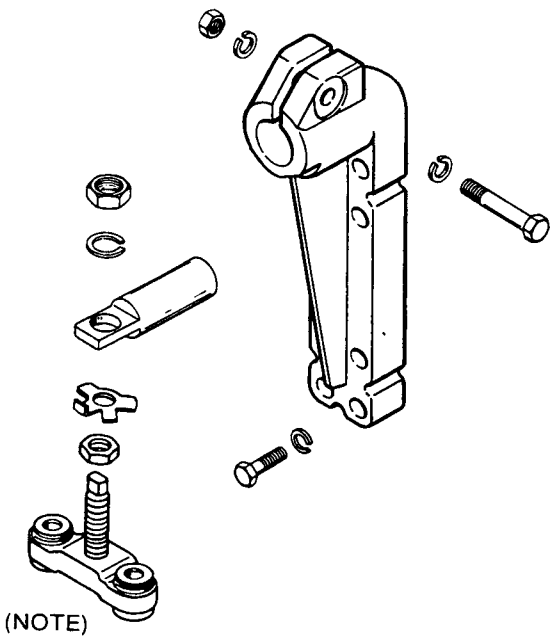


a - Gasket used on MCM Engines Only

REAR MOUNT/FLYWHEEL HOUSING - MCM 5.0/5.7 Litre (305/350 CID) Engines

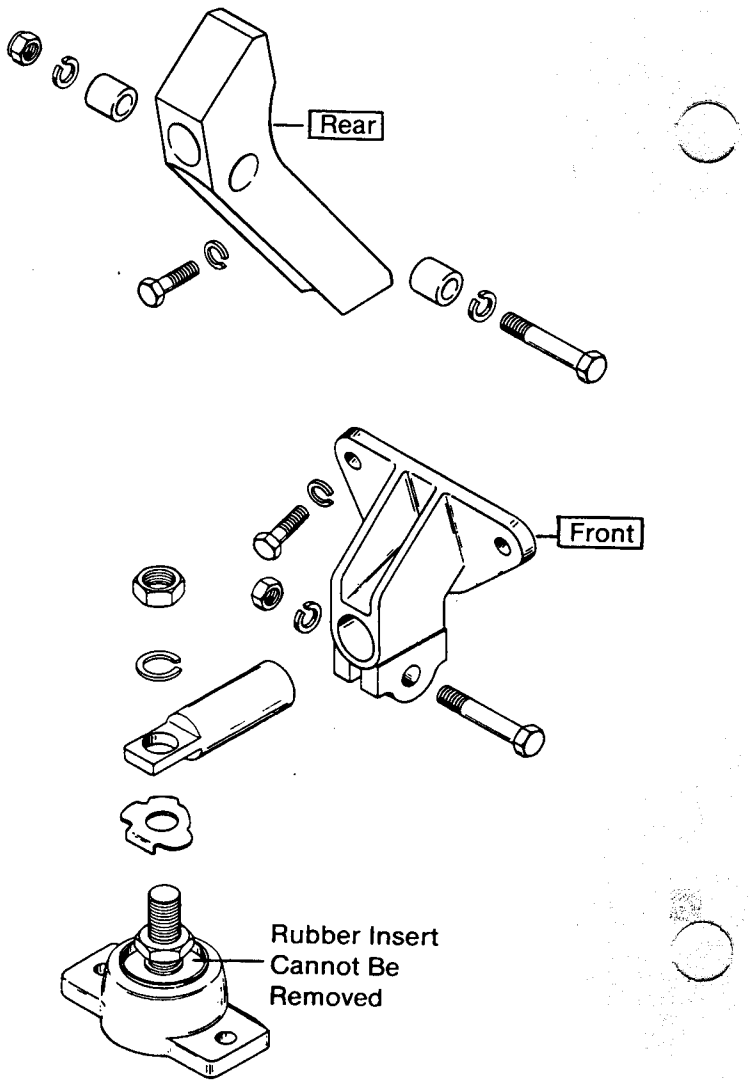


FRONT/REAR MOUNTS - MIE 5.0/5.7 Litre (305/ 350 CID) In-Line Transmission Engines

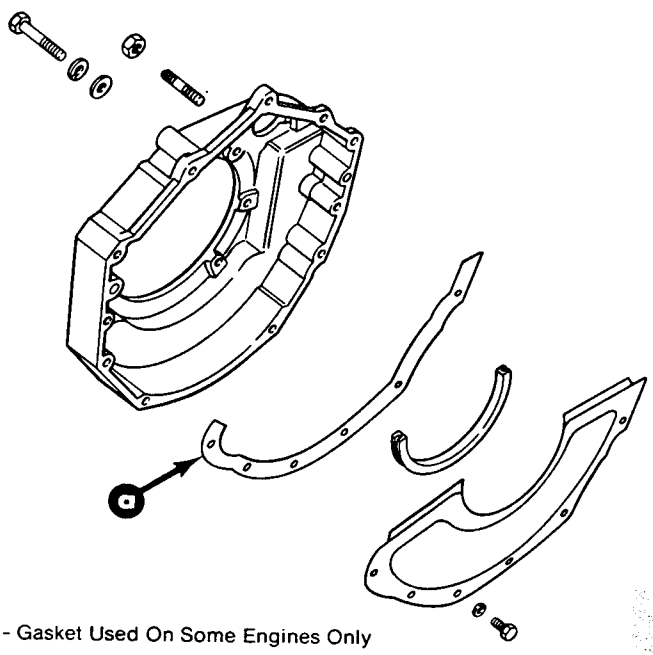


REAR MOUNT - MIE 5.7 Litre (350 CID) Hurth

(NOTE: Longer retaining fastener required)



FRONT/REAR MOUNTS - MIE 5.0/5.7 Litre (305/ 350 CID) V-Drive Engines



a - Gasket Used On Some Engines Only

FLYWHEEL HOUSING - MIE 5.0/5.7 Litre (305/ 350 CID) Engines

Rocker Arm Cover

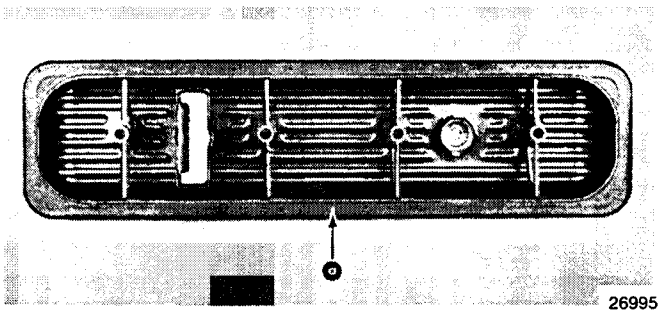
Removal

On engines with Center Exhaust Outlet exhaust manifolds: It may be necessary to remove exhaust manifold before removing rocker arm cover. Also remove any component that will interfere with the removal of the manifold or rocker arm cover.

1. Disconnect crankcase ventilation hoses.
2. Remove any items that interfere with the removal of rocker arm covers.
3. Remove rocker arm cover.

Installation

1. Clean sealing surfaces on cylinder head and rocker arm cover with degreaser.
2. Place new rocker arm cover gasket (a) in position in rocker arm cover.



3. Install rocker arm cover. Torque screws to 90 lb. in. (10 N·m).
4. Reinstall exhaust manifolds, if removed.
5. Reinstall any items which were removed to allow removal of rocker arm covers.
6. Connect crankcase ventilation hoses to rocker arm covers.
7. Start engine and check for oil leaks.

Intake Manifold

Removal

1. Drain engine cooling system.
2. Disconnect hoses from thermostat housing.
3. Disconnect all electrical leads.
4. Disconnect crankcase ventilation hoses from rocker arm covers.
5. Disconnect throttle cable from carburetor. Remove fuel line running between fuel pump and carburetor.
6. Remove distributor cap and mark position of rotor on distributor housing. Also, mark position of distributor housing on intake manifold. Remove distributor.

IMPORTANT: Do not crank engine over after distributor has been removed.

7. Remove other ignition components.
8. Remove oil sending unit.
9. Disconnect any other miscellaneous items that will prevent removal of manifold.

IMPORTANT: It may be necessary to pry intake manifold away from cylinder heads and block, in next step. Use extreme care to prevent damage to sealing surfaces.

10. Remove intake manifold screws, then remove intake manifold and carburetor assembly.

NOTE: If intake manifold requires replacement, transfer all remaining parts to new manifold.

Cleaning and Inspection

1. Clean gasket material from all mating surfaces.

IMPORTANT: When cleaning cylinder head mating surface, do not allow gasket material to enter engine crankcase or intake ports.

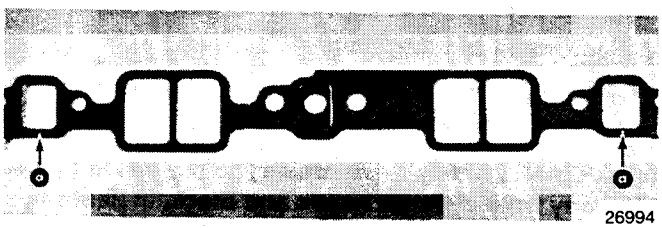
2. Inspect manifold for cracks or scratches. Machined surfaces must be clean and free of all marks, or deep scratches or leaks may result.
3. Check intake passages for varnish buildup or other foreign material. Clean as necessary.

Installation

IMPORTANT: When installing intake manifold gaskets, in next step, be sure to do the following:

- **Be sure to install gasket with marked side up. Both gaskets are identical.**
- **On 305 C.I.D. engines with 2 barrel carburetor, remove metal insert from manifold gasket to be used on starboard (right) cylinder head to provide clearance for heat pipe on intake manifold.**
- **All MerCruiser V-8 G.M engines that have "automatic" carburetor chokes must use an intake gasket that has an opening for the exhaust crossover port in the intake manifold. Without this opening the "automatic" carburetor choke will not operate properly. The choke will remain "ON" longer causing rough engine operation and wasted fuel.**

1. Apply Perfect Seal to intake manifold gaskets around coolant passages (a) [both sides].



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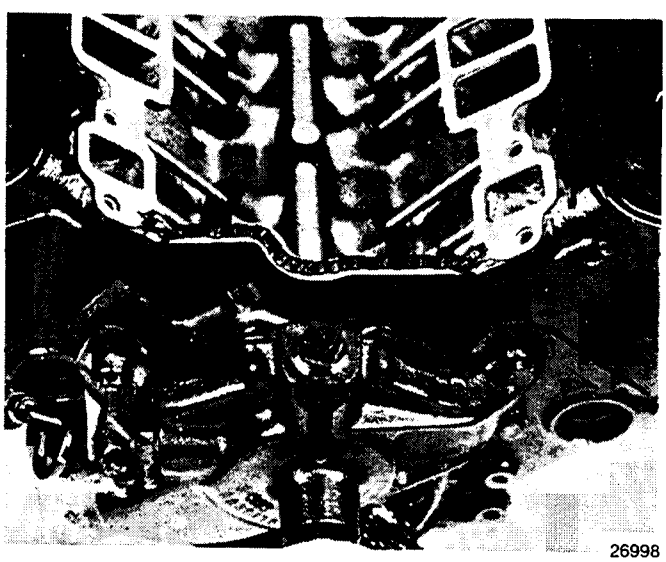
2. Place gaskets on cylinder heads.
3. Apply a 3/16 in. (5mm) wide bead of RTV Sealer to engine block as shown. Extend sealer 1/2 in. (13mm) up on intake gaskets.

IMPORTANT: DO NOT get RTV Sealer into oil sending unit hole (a) at rear of engine.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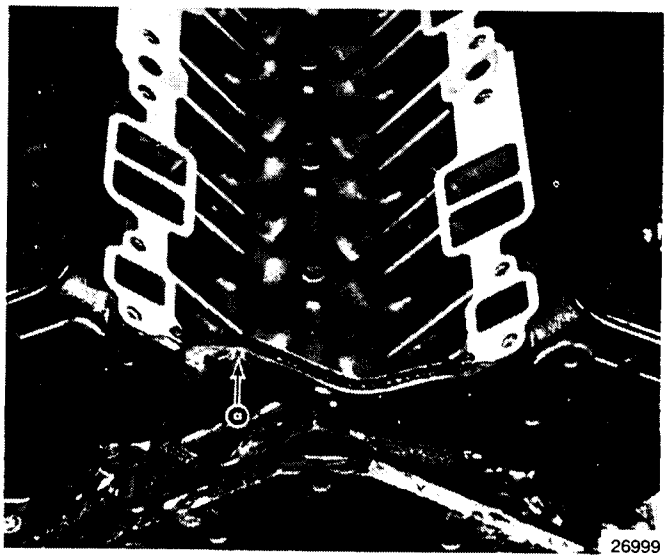
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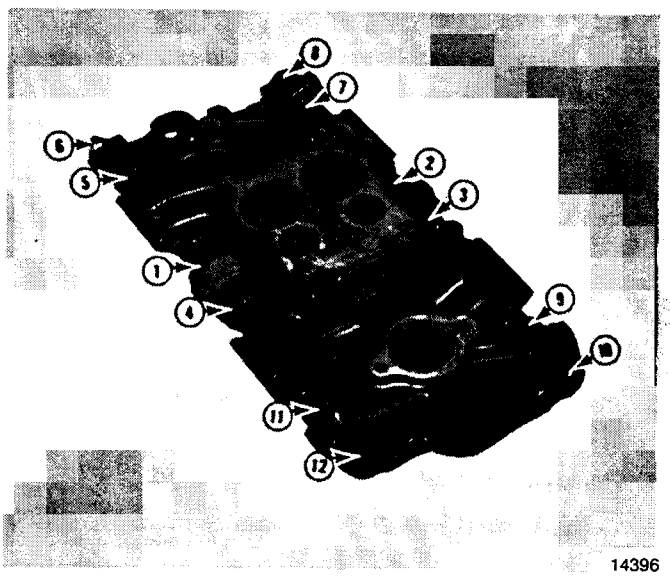
4. Carefully install manifold assembly and torque bolts to 35 lb. ft. (48 N·m) in sequence as shown.



14396

305/350 CID Manifold Torque Sequence Intake

5. Connect all electrical leads.
6. Reconnect hoses to thermostat housing.
7. Install fuel line to carburetor and fuel pump.
8. Connect crankcase ventilation hoses to rocker arm covers.
9. Install distributor. Position rotor and housing to align with marks made during removal, then install distributor cap.
10. Install other ignition components and reconnect wires.
11. Coat threads of oil pressure sending unit with Perfect Seal and install.

12. Reconnect any other items which were disconnected from manifold during the removal.
13. Start engine. Adjust ignition timing and carburetor. Check hose connections, gaskets and seals for leaks.
14. Inspect fuel line connections for fuel leaks.

Rocker Arm/Push Rod

Removal

NOTE: When servicing only one cylinder's rocker arms, bring that cylinder's piston up to TDC before removing rocker arms. When servicing all rocker arms, bring number 1 piston up to TDC before removing rocker arms.

1. Remove rocker arm covers as outlined.
2. Remove rocker arm assemblies and push rods.

IMPORTANT: Place rocker arm assemblies and push rods in a rack for reassembly in their original locations.

Cleaning and Inspection

1. Clean parts with solvent and dry with compressed air.
2. Inspect all contact surfaces for wear. Replace all damaged parts.

Installation

IMPORTANT: When installing rocker arms and rocker arm balls, coat bearing surfaces of rocker arms and rock arm balls with engine oil.

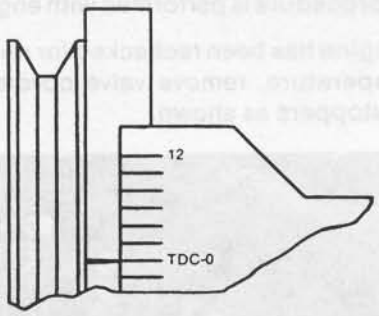
1. Install push rods in their original locations. Be sure push rods seat in lifter socket.
2. Install rocker arms, rocker arm balls and rocker arm nuts in their original locations.
3. Adjust valves as outlined under "Valve Adjustment - Engine Stopped."

Valve Adjustment

Engine Stopped

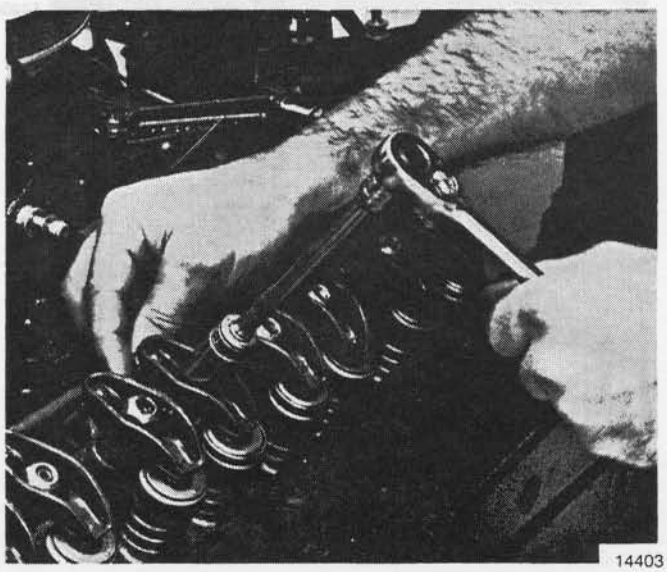
With valve cover removed, adjust valves when lifter is on low part of camshaft lobe, as follows:

1. Crank engine with starter or turn over in normal direction of rotation until mark on torsional damper lines up with center "O" mark on timing tab, and engine is in No. 1 firing position. This may be determined by placing fingers on No. 1 valve as mark on damper comes near "O" mark on timing mark. If valves move as mark comes up to timing tab, engine is in No. 6 firing position and should be turned over one more time to reach No. 1 position.
2. With engine in No. 1 firing position as determined above, the following valves may be adjusted.



3. **MCM and MIE Left Hand (Standard) Rotation Engines:**
   Exhaust - 1-3-4-8 Intake - 1-2-5-7

   MIE Right Hand (Opposite) Rotation Engines:
   Exhaust - 1-2-5-7 Intake - 1-3-4-8
4. Back out adjusting nut until lash is felt at push rod, then turn in adjusting nut until all lash is removed. This can be determined by moving push rod up-and-down while turning adjusting nut until all play is removed.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Valve Adjustment

5. Hydraulic lifters now can be adjusted by tightening adjustment nut an additional 1-turn. No other adjustment is required.
6. Crank engine one revolution until pointer "O" mark and torsional damper mark are again in alignment. This is No. 6 firing position. With engine in this position, the following valves may be adjusted as previously outlined.
7. **MCM and MIE Left Hand (Standard) Rotation Engines:**
   Exhaust - 2-5-6-7 Intake - 3-4-6-8

   MIE Right Hand (Opposite) Rotation Engines:
   Exhaust - 3-4-6-8 Intake - 2-5-6-7

Engine Running

Following procedure is performed with engine running:

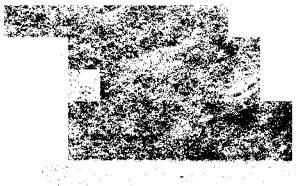
1. After engine has been rechecked for normal operating temperature, remove valve covers and install rocker stoppers as shown.

Rocker Stoppers 91-66273

2. With engine running at idle, loosen rocker arm nut (one at a time) until rocker arm starts to clatter.
3. Turn rocker arm nut down until clatter just stops. This is zero lash position.
4. Turn nut down 1/4 additional turn and pause 10 seconds until engine runs smoothly. Repeat until nut has been turned down 1-turn from the zero lash position.

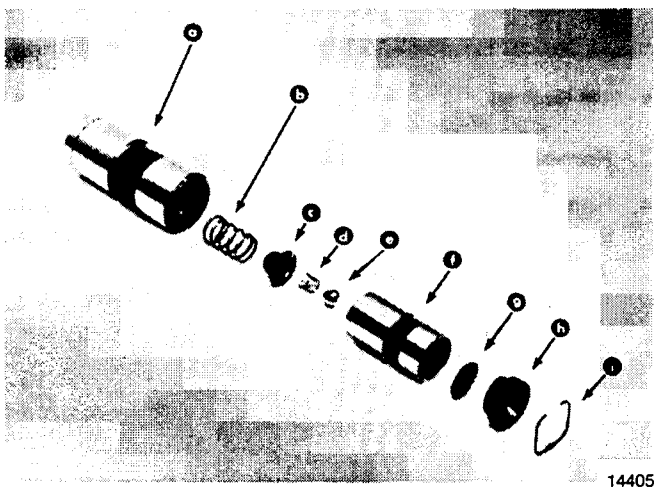
IMPORTANT: This 1-turn preload adjustment must be done slowly to allow the lifter to adjust itself and prevent the valves from hitting the pistons, causing internal damage and/or bent push rods.

5. Repeat Steps 2-3-4 to adjust other valves.
6. Remove rocker stoppers after all valves are adjusted.
7. Install valve covers, torque screws to 90 lb. in. (10 N·m).
8. Adjust carburetor idle mixture and idle speed. Check for leaks.



Hydraulic Valve Lifters (Flat and Roller Lifter)

Roller Hydraulic Valve Lifter Assembly



a - Lifter Body
b - Plunger Spring
c - Check Ball Retainer
d - Check Ball Spring
e - Check Ball
f - Plunger
g - Metering Valve
h - Push Rod Seat
i - Push Rod Seat Retainer

Flat Hydraulic Valve Lifter Assembly

Hydraulic valve lifters require little attention. Lifters are extremely simple in design. Normally, readjustments are not necessary and servicing requires only that care and cleanliness be exercised in the handling of parts.

LOCATING NOISY LIFTERS

Locate a noisy valve lifter by using a piece of garden hose approximately 4 ft. (1.2m) in length. Place one end of hose near end of each intake and exhaust valve, with other end of hose to the ear. In this manner, sound is localized, making it easy to determine which lifter is at fault.

Another method is to place a finger on face of valve spring retainer. If lifter is not functioning properly, a distinct shock will be felt when valve returns to its seat.

General types of valve lifter noise are as follows:

1. Hard rapping noise -- Usually caused by plunger becoming tight in bore of lifter body so that return spring cannot push plunger back up to working position. Probable causes are:
   a. Excessive varnish or carbon deposit, causing abnormal stickiness.
   b. Galling or "pick-up" between plunger and bore of lifter body, usually caused by an abrasive piece of dirt or metal wedged between plunger and lifter body.
2. Moderate rapping noise -- Probable causes are:
   a. Excessively high leakdown rate.
   b. Leaky check valve seat.
   c. Improper adjustment.
3. General noise throughout valve train -- This will, in most cases, be a definite indication of insufficient oil supply or improper adjustment.
4. Intermittent clicking -- Probable causes are:
   a. A piece of dirt momentarily caught between ball seat and check valve ball.
   b. In rare cases, ball itself may be out-of-round or have a flat spot.
   c. Improper adjustment.

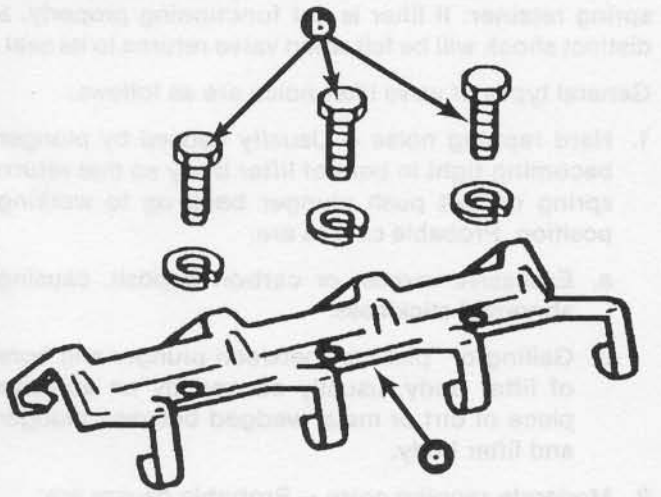
In most cases, where noise exists in one or more lifters, all lifter units should be removed, disassembled, cleaned in solvent, reassembled and reinstalled in engine. If dirt, corrosion, carbon, etc., is shown to exist in one unit, it more likely exists in all the units, thus it would only be a matter of time before all lifters caused trouble.

REMOVAL

IMPORTANT: Keep push rod and hydraulic valve lifter from each valve together as a matched set and mark them so they can be reinstalled in the same location later.

1. Remove rocker arm covers.
2. Remove intake manifold.
3. Remove restrictor retainer on roller lifter models.
4. Remove rocker arm assemblies and push rods.

NOTE: Engines equipped with roller lifters have additional valve train components shown below.



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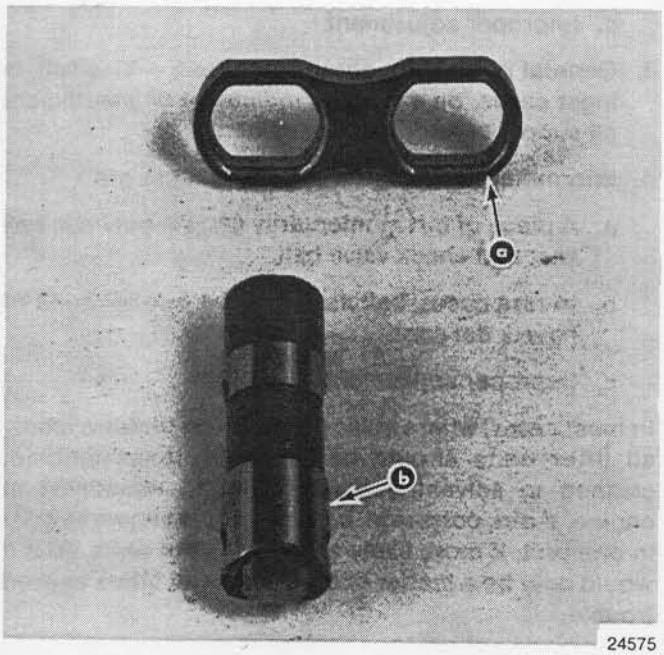
a - Lifter Restrictor Retainer
b - Fasteners



24575

a - Roller Lifter Restrictor
b - Roller Lifter

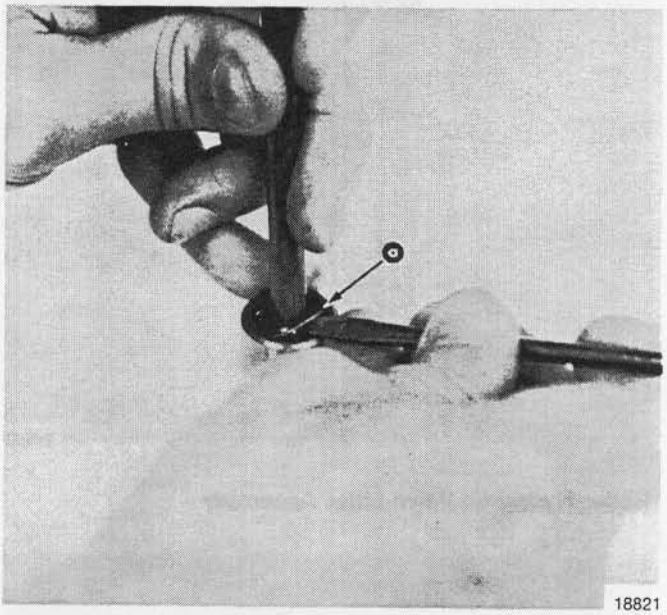
5. Remove Lifter Restrictors, on roller lifter engines. Remove valve lifters on all engines.

DISASSEMBLY

IMPORTANT: The internal parts of each hydraulic lifter assembly are matched sets. Do not intermix the parts.

IMPORTANT: Roller lifters must be replaced if the roller tip is worn or damaged and does not roll freely or smoothly. Do not disassemble.

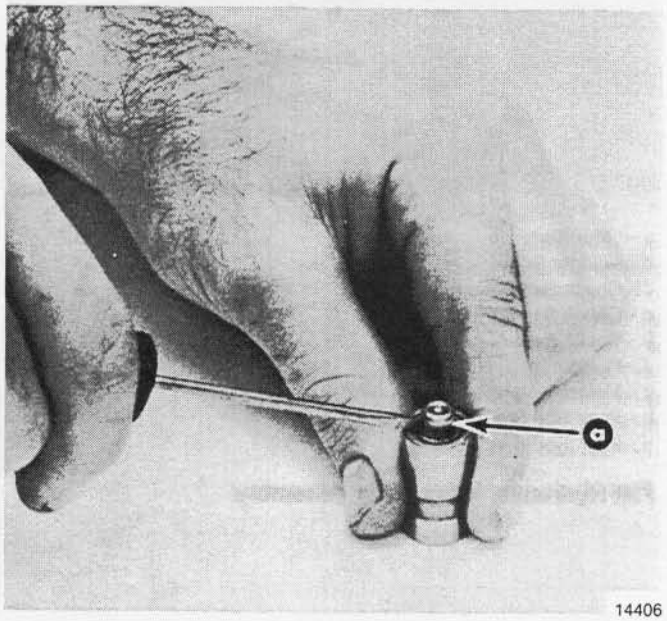
1. Hold plunger down with a push rod and remove push rod seat retainer with the blade of a small screwdriver.
2. Remove push rod seat and metering valve.



18821

a - Seat Retainer

3. Remove the plunger, and the plunger spring.
4. Remove the ball check valve and spring by prying the ball retainer loose from the plunger with the blade of a small screwdriver.



14406

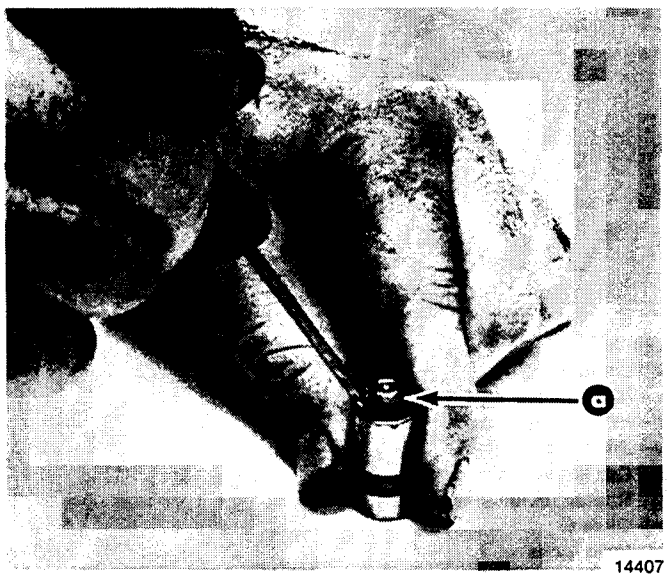
a - Check Ball Retainer

CLEANING and INSPECTION

Thoroughly clean all parts in cleaning solvent and inspect them carefully. If any parts are damaged or worn, entire lifter assembly should be replaced. If outer lifter body wall is scuffed or worn, roller tip tight or worn, inspect cylinder block lifter bore. If bottom of lifter is scuffed or worn, inspect camshaft lobe. If push rod seat is scuffed or worn, inspect push rod.

REASSEMBLY

1. Place the check ball in small hole in bottom of the plunger.
2. Insert check ball spring on seat in ball retainer and place retainer over ball so that spring rests on the ball. Carefully press the retainer into position in plunger with the blade of a small screwdriver.



14407

a - Check Ball Retainer

3. Place the plunger spring over the ball retainer and slide the lifter body over the spring and plunger, being careful to line up the oil feed hole in the lifter body and plunger.
4. Fill the assembly with oil, then insert the end of a 1/8 in. drift pin into the plunger and press down on check ball until hole in lifter body aligns with hole in plunger.
5. Insert a 1/16 in. drift pin through both oil holes to hold the plunger down against the lifter spring tension.

IMPORTANT: DO NOT attempt to force or pump the plunger.

6. Remove the 1/8 in. drift pin and refill assembly with oil.

14408

7. Install the metering valve, push rod seat and push rod seat retainer.
8. Press down on the push rod seat with a push rod and remove 1/16 in. drift pin from lifter.

INSTALLATION

IMPORTANT: Before installing lifters/rollers, coat the bottom of the lifter/roller with engine oil. If new lifters or a new camshaft has been installed, an additive containing EP lube (such as Quicksilver Engine Oil Supplement) should be poured over camshaft lobes before installing lifters.

IMPORTANT: It is recommended that the engine oil be changed and a new oil filter be installed whenever servicing valve lifters or camshaft.

IMPORTANT: Before installation, coat entire valve lifter with engine oil. DO NOT install used valve lifters if a new camshaft has been installed.

1. Install hydraulic valve lifters, and components. Torque roller lifter restrictor retainer plate fasteners to 144 lb. in. (16 N·m), on roller lifter engines.
2. Install intake manifold.
3. Install and adjust valve mechanism as outlined.
4. Install rocker arm cover.
5. Start engine and check for leaks.

Valve Stem Oil Seal/Valve Spring

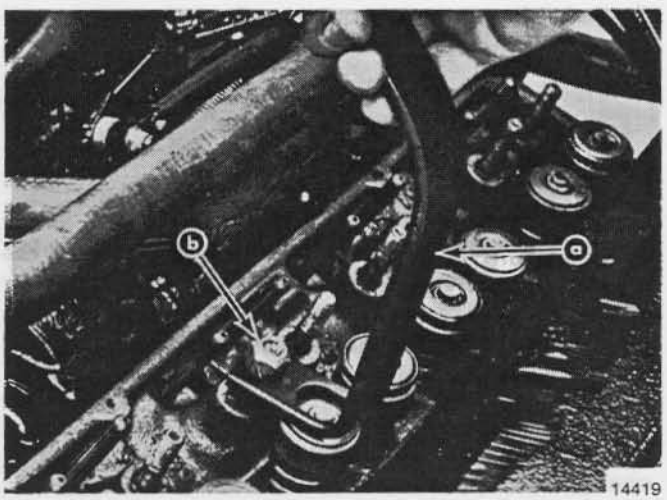
Removal - Head Installed

1. Remove:
   a. rocker arm cover
   b. spark plug
   c. rocker arm assembly.
2. Install air line adaptor tool J-23590 in spark plug hole and apply compressed air to hold valves in place.

NOTE: If compressed air is not available, piston may be brought up to TDC and used to keep valves from falling out of valve guides.

IMPORTANT: Do not turn crankshaft while valve springs, retainers, and locks are removed or valves will fall into cylinder.

3. Using tool J-5892 as shown, compress valve spring and remove valve locks.



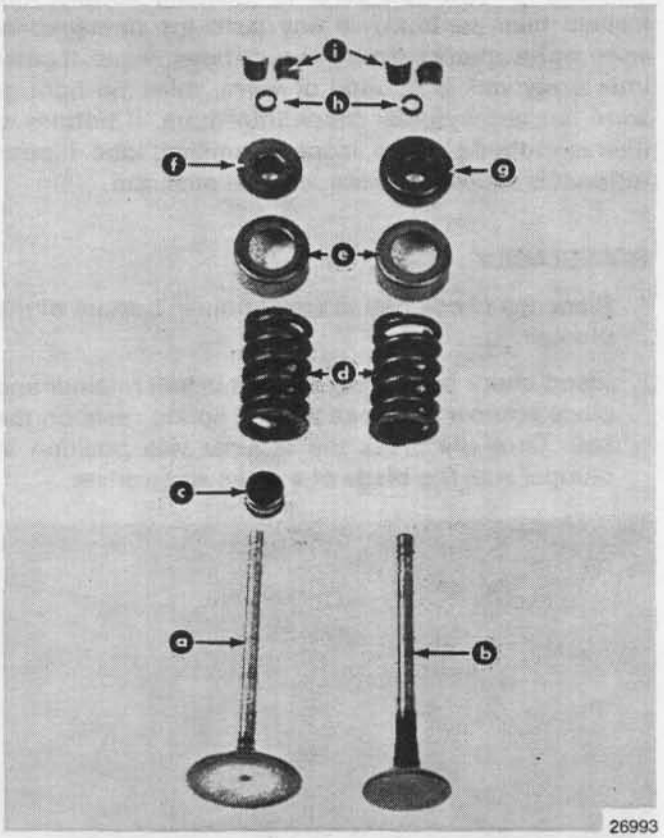
a - Tool J-5892
b - Rocker Arm Nut

4. Slowly release tool. Remove cap, shield, and valve spring.

IMPORTANT: Keep air pressure in cylinder while springs, caps, and valve locks are removed or valves will fall into cylinder.

5. Remove seals from valve stems and valve guide.

Valve Assembly (Exploded View)

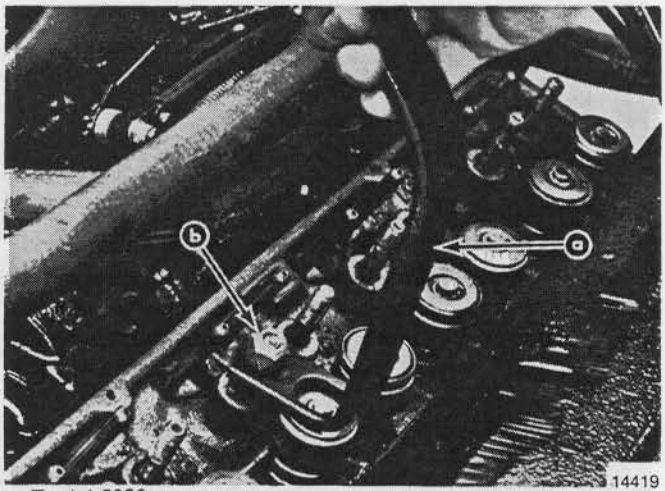


a - Intake valve
b - Exhaust valve
c - Valve guide seal (intake only)
d - Valve spring with damper
e - Shield
f - Cap (intake valve only)
g - Rotator (exhaust valve only)
h - Oil seal
i - Valve locks

Installation - Head Installed

1. Install valve guide seal (intake valve only) over valve stem and push down until seated against head.
2. Set valve spring (with damper installed) and shield in place.
3. Place cap on intake valve and/or rotator on exhaust valve.
4. While compressing valve spring with tool J-5892, install oil seal in lower groove of valve stem, making sure seal is not twisted. A light coating of oil will help prevent twisting.

5. Install valve locks (grease may be used to hold them in place) and slowly release tool, making sure locks seat properly in upper grooves of valve stem.



a - Tool J-5892
b - Rocker Arm Nut

Compressing Valve Spring

6. Install push rods and rocker arm assemblies.
7. Adjust valves as outlined under "Valve Adjustment - Engine Stopped."
8. Install rocker arm cover [torque to 90 lb. in. (10 N·m)] and spark plug [torque to 15 lb. ft. (20 N·m)].

Cylinder Head

Removal

1. Drain engine cooling system.
2. Remove as outlined:
   a. Exhaust manifolds
   b. Intake manifold
   c. Rocker arm covers
   d. Rocker arm assemblies and push rods (keep in order for reassembly in their original locations)
   e. Any components attached to front or rear of cylinder head
   f. Spark plugs
   g. Head bolts.

⚠CAUTION

The head gasket may be holding cylinder head to block. Use care when prying off cylinder heads. DO NOT damage gasket surfaces. DO NOT drop cylinder heads.

3. Place cylinder head on wooden blocks to prevent damage to gasket surfaces.

Cleaning and Inspection

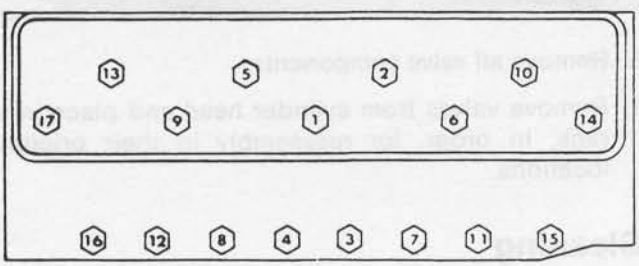
Clean gasket material and sealer from engine block and cylinder heads. Inspect sealing surfaces for deep nicks and scratches. Look for corrosion around cooling passages. Clean head bolt threads and engine block bolt hole threads.

Installation

⚠CAUTION

When using ribbed stainless steel head gaskets, apply a thin coating of Perfect Seal to both sides of gasket. Too much sealer may hold gasket away from head or block causing leakage. DO NOT use sealer on graphite composition head gaskets.

1. Place head gasket in position over dowel pins.
2. Carefully set cylinder head in place over dowel pins.
3. Coat threads of head bolts with Perfect Seal and install finger-tight.
4. To insure gasket sealing, torque head bolts in three steps, following torque sequence for each step. Start first step at 20 lb. ft. (27 N·m), second step at 40 lb. ft. (54 N·m), and finish with a final torque of 65 lb. ft. (88 N·m).



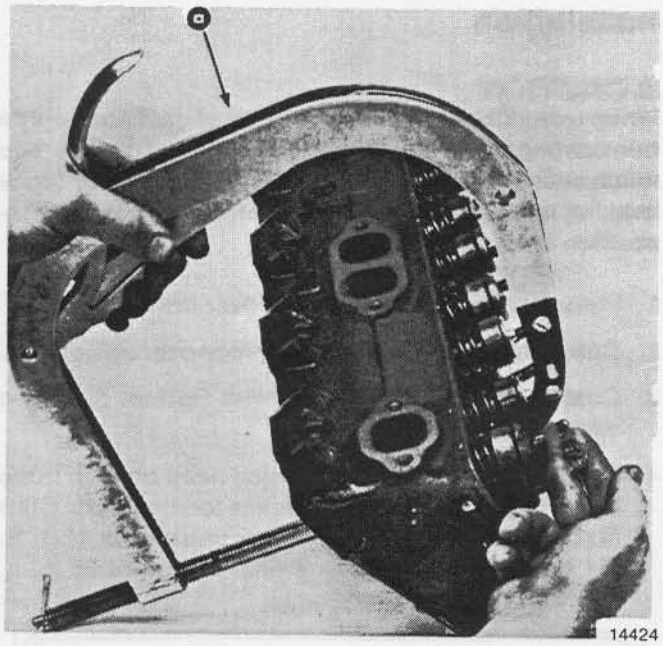
Cylinder Head Torque Sequence

5. Install push rods and rocker arm assemblies in their original positions.
6. Adjust valves as outlined under "Valve Adjustment - Engine Stopped."
7. Install as outlined:
   a. Intake manifold
   b. Rocker arm covers
   c. Exhaust manifolds
   d. Spark plugs
   e. Any components removed from front or rear of cylinder heads
8. Start engine, set timing, set idle speed, and check for leaks.

Cylinder Head and Valve Conditioning

Disassembly

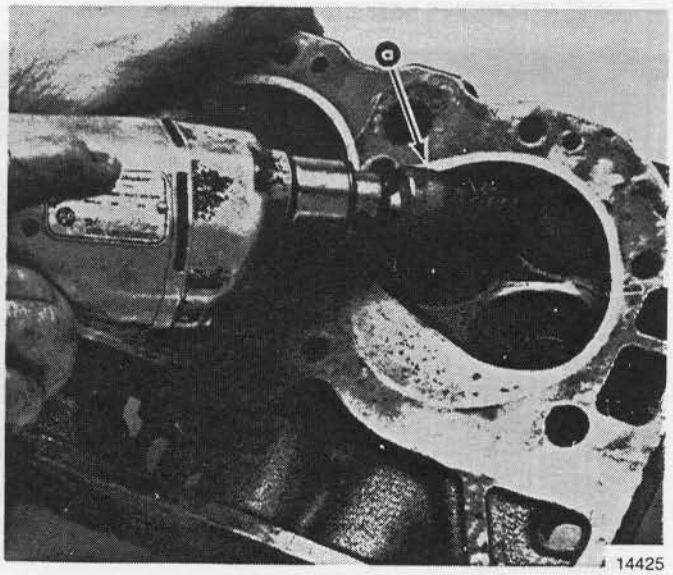
1. Using Tool J-8062 (a), compress valve spring and remove valve locks. Slowly release tool.



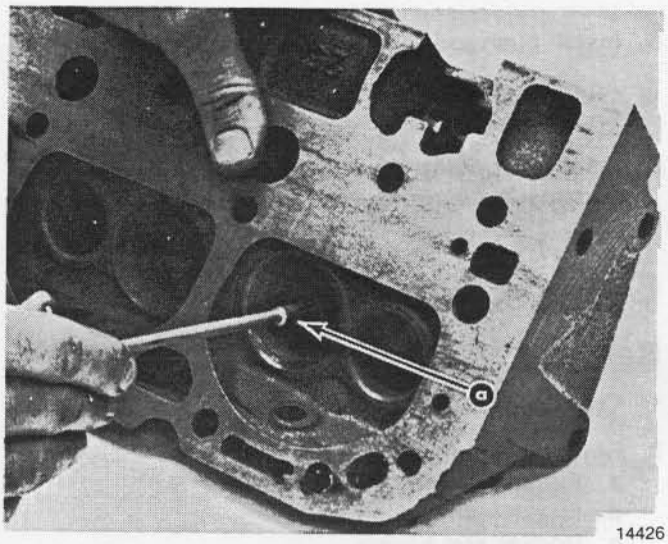
2. Remove all valve components.
3. Remove valves from cylinder head and place in a rack, in order, for reassembly in their original locations.

Cleaning

1. Clean push rods and rocker arm assemblies.
2. Clean carbon from valves using a wire wheel.
3. Clean gasket material from cylinder head mating surfaces.
4. Clean all carbon from combustion chambers and valve ports using tool J-8089 (a).

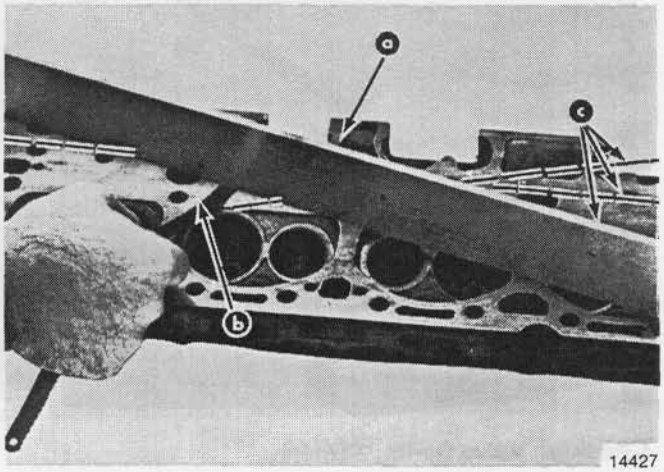


5. Thoroughly clean valve guides with tool J-8101 (a).



Inspection

1. Inspect cylinder heads for cracks in exhaust ports, water jackets, and combustion chambers (especially around spark plug holes and valve seats). Replace heads if any cracks are found.
2. Inspect cylinder head gasket surface for burrs, nicks, erosion or other damage. Also, check flatness of cylinder head gasket surface, using a machinists straight edge and feeler gauges as shown. Refer to "Specifications."



14427

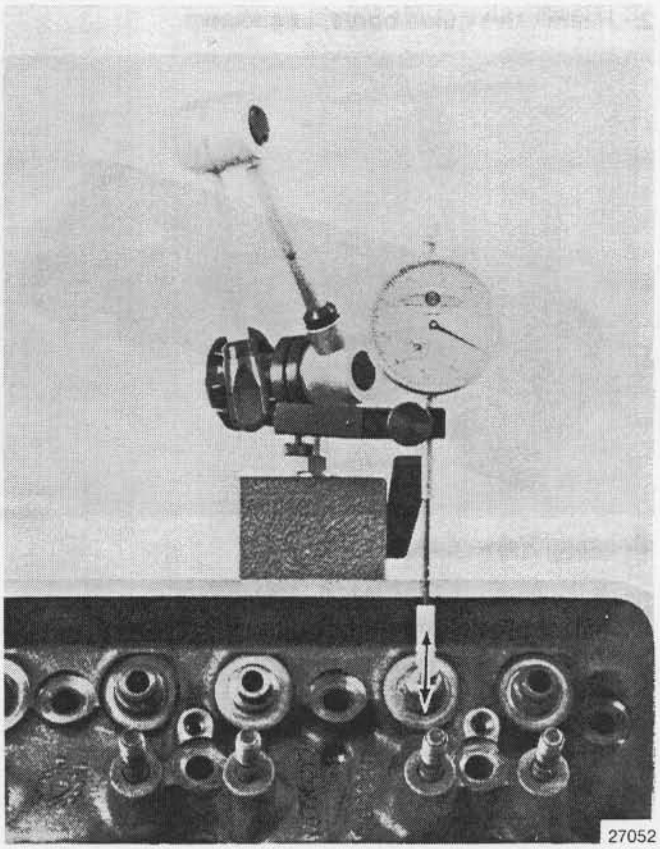
a - Straight Edge
b - Feeler Gauge
c - Take Measurements Diagonally Across Head (Both Ways) and Straight Down Center Head

IMPORTANT: Cylinder head to block gasket surface should be resurfaced if out-of-flat more than specified. When resurfacing, cylinder head to intake manifold gasket surface also must be milled to provide proper alignment between intake manifold and head.

3. Inspect valves for burned heads, cracked faces or damaged stems.

IMPORTANT: Excessive valve stem to bore clearance will cause excessive oil consumption and possible valve breakage. Insufficient clearance will result in noisy and sticky valves.

4. Measure valve stem clearance as follows:
   a. Attach a dial indicator to cylinder head, positioning it against the valve stem and close to the valve guide.
   b. Holding valve head off seat about 1/16 in. (2mm), move valve stem back and forth in direction shown. Compare stem clearance with specifications.
   c. If clearance exceeds specifications, it will be necessary to ream valve guides for oversized valves, as outlined under "Valve Guide Bore Repair."


27052

Valve Guide Bore Repair

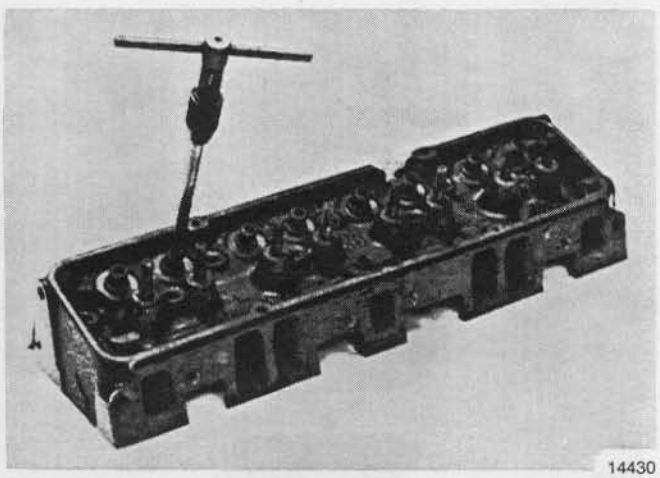
IMPORTANT: Be sure to measure valve stem diameter of both the intake and exhaust valve, as valve stem diameter may or may not be the same for both valves.

If .015 in. oversize valves are required ream valve guide bores for oversize valves, as follows:

1. Measure valve stem diameter of old valve being replaced and select proper size Valve Guide Reamer from chart below.

Standard Valve Stem Diameter	Reamer Required for .015 in. Oversize Valve
.341 in.	J-5830-2
.372 in.	J-7049

2. Ream valve guide bores, as shown.



Reaming Valve Guides

3. Remove the sharp corner created by reamer at top of valve guide.

Valve Springs - Checking Tension

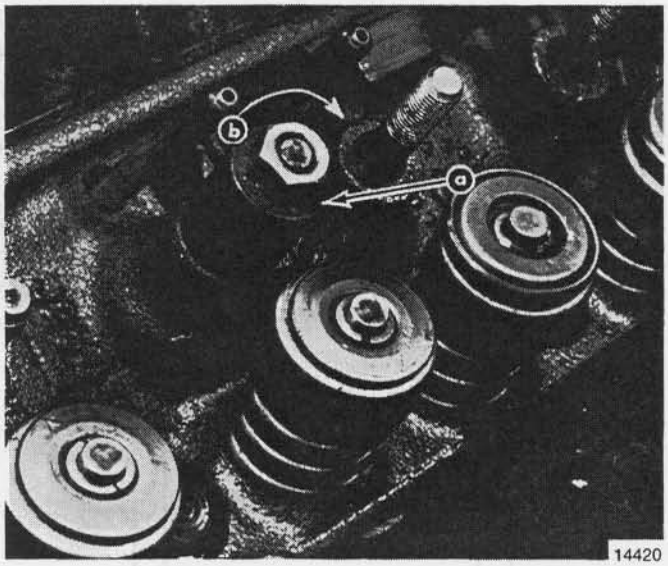
Using tester J-8056, as shown, check valve spring tension with dampers removed. Refer to "Specifications."

IMPORTANT: Springs should be replaced if not within 10 lb. in. (1.1 N·m) of specified tension.

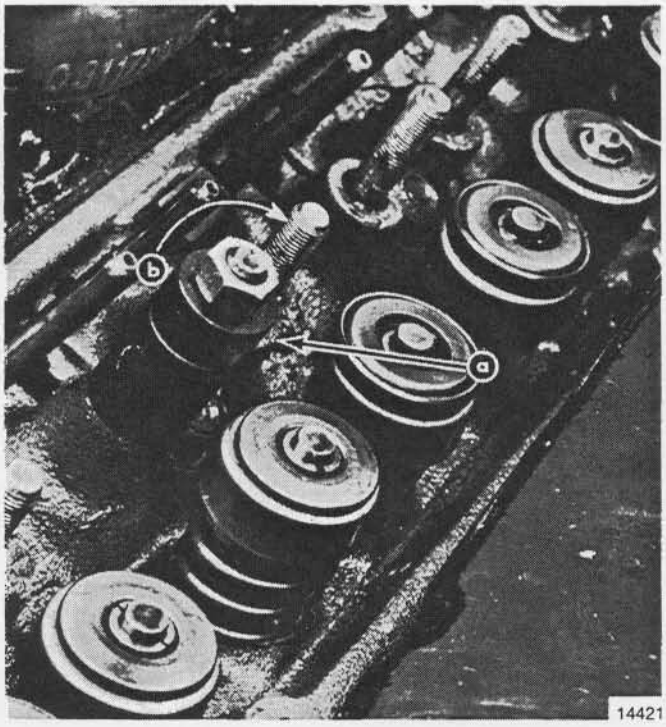
Checking Valve Spring Tension

Rocker Arm Stud Replacement

1. Rocker arm studs, which are worn or loose, should be replaced with oversize studs.
2. Use Tool J-5802-01 to remove old stud by placing tool, flat washer and nut over stud, then turning nut.



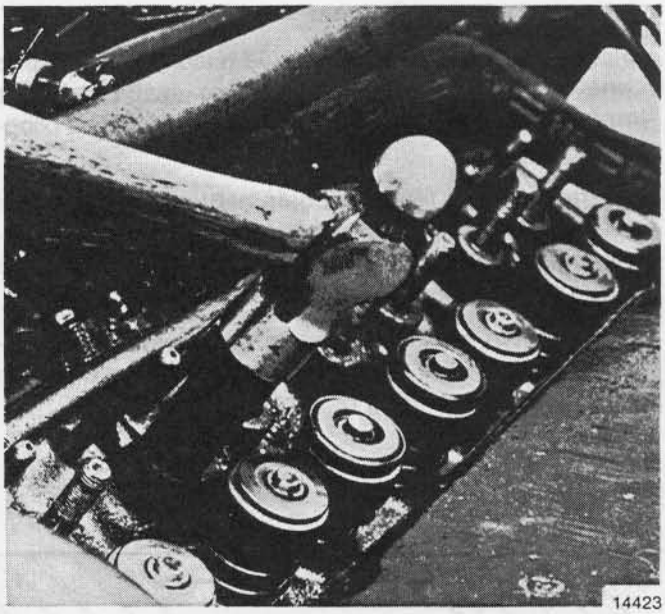
a - Large Sleeve
b - 3/8 x 24 Nut - Turn until Nut Bottoms Out on Stud Threads, Then Remove Nut



a - Install Small Sleeve
b - Turn Nut to Remove Stud

Removing Stud using Tool J-5802-01

3. Ream stud hole, whenever installing an oversize stud, using appropriate reaming tool.
4. Install new stud with Tool J-6880.



Installing Stud using Tool J-6880

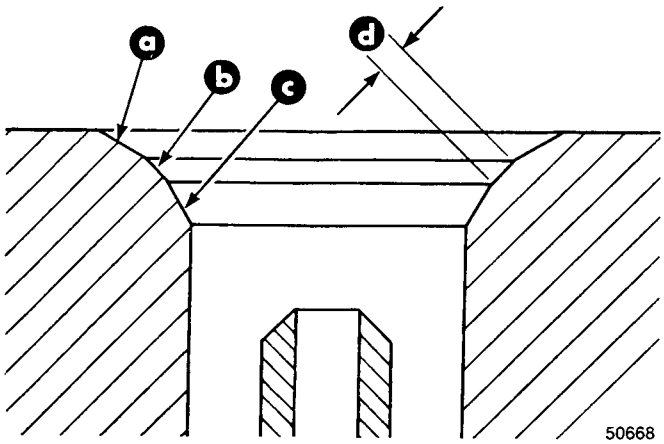
Valve Seat Repair

Valve seat reconditioning is very important, since seating of valves must be perfect for engine to deliver maximum power and performance.

Another important factor is valve head cooling. Good contact between each valve and its seat in head is important to insure that heat in valve head will be properly dispersed.

Several different types of equipment are available for reseating valve seats. Equipment manufacturer's recommendations should be followed carefully to attain proper results.

Regardless of type of equipment, however, it is essential that valve guide bores be free from carbon or dirt to insure proper centering of pilot in valve guide.



a - Top Angle (30°)
b - Seat Angle (46°)
c - Bottom Angle (60°)
d - Seat Width:
Intake 1/32 [.031]-1/16 [.063] in (.79-1.59mm)
Exhaust 1/16 [.063]-3/32 [.094] in (1.59-2.38mm)

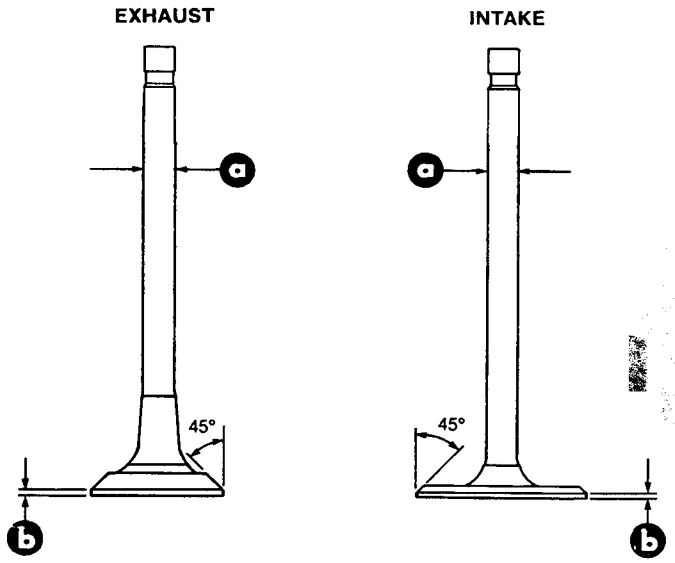
Typical "3 Angle" Valve Seat

Measuring Valve Seat Out-of-Round

Valve Grinding

Valves that are pitted must be refaced to the proper angle. Valve stems which show excessive wear, or valves that are warped excessively must be replaced. When a valve head which is warped excessively is refaced, a knife edge will be ground on part or all of the valve head, due to the amount of metal that must be removed to completely reface. Knife edges lead to breakage, burning, or pre-ignition due to heat localizing on this knife edge. If the edge of the valve head is less than 1/32 in. (.8mm) after grinding, replace the valve.

Several different types of equipment are available for refacing valves. The recommendation of the manufacturer of the equipment being used should be carefully followed to attain proper results.

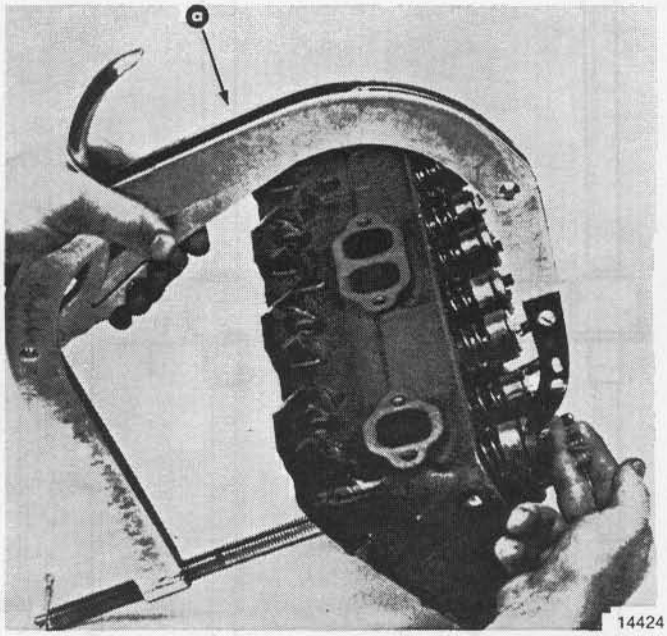


Exhaust
a - .372 in. (9.45mm)
b - 1/32 [.031] in. (.79mm) min.

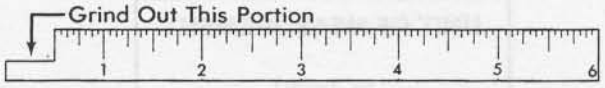
Intake
a - .341 in. (8.16mm)
b - 1/32 [.031] in. (.79mm) min.

Reassembly

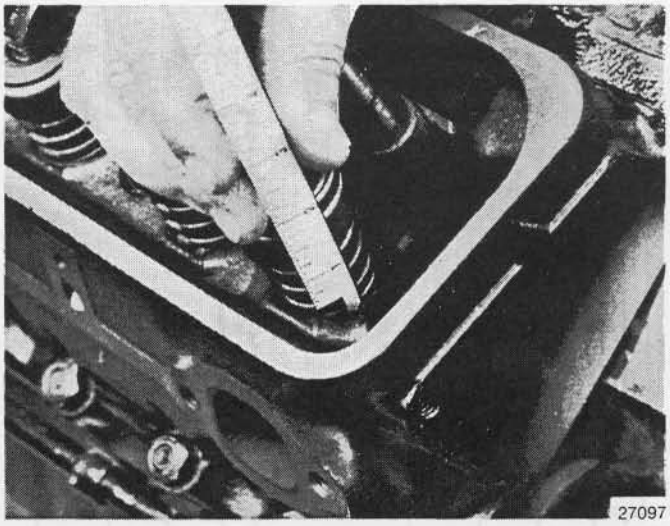
1. Lubricate valve guides and valve stems with engine oil.
2. Install each valve in the port from which it was removed or to which it was fitted.
3. Install valve guide seal (intake valve only) over valve stem and push down until seated against head.
4. Set valve spring (with damper installed) and shield in place.
5. Place cap on intake valve and/or rotator on exhaust valve.
6. While compressing valve spring with tool J-8062 (a), install oil seal in lower groove of valve stem, making sure seal is not twisted. A light coating of oil will help prevent twisting.



7. Install valve locks (grease may be used to hold them in place) and slowly release tool, making sure locks seat properly in upper grooves of valve stem.
8. Check installed height of valve springs using a narrow, thin scale. Measure from spring seat to top of valve spring, as shown. If measurement exceeds specified height, install a valve spring shim and recheck. DO NOT shim valve springs to give an installed height less than the minimum specified.



Cutaway Scale

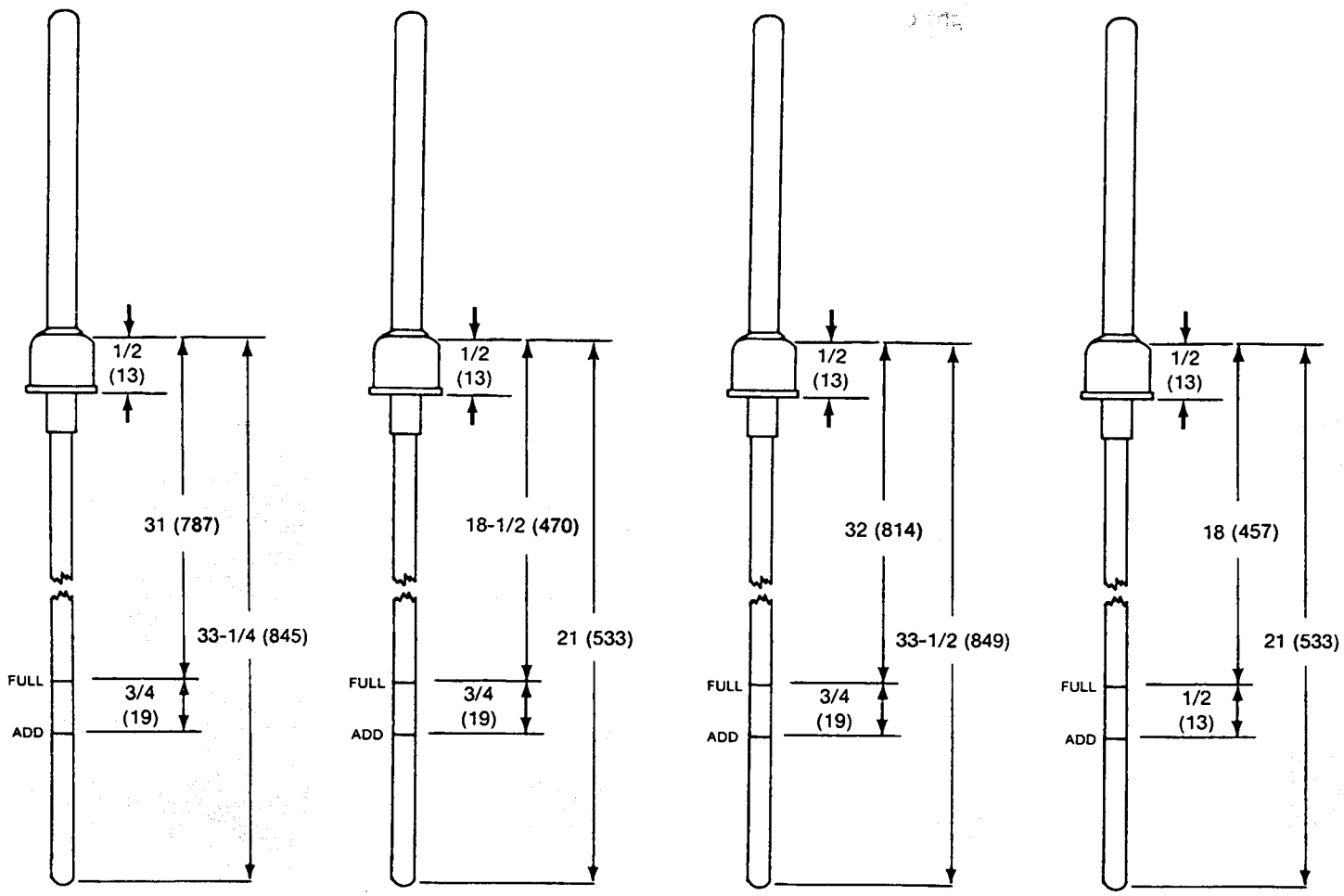


Measuring Valve Spring Installed Height

Dipstick Specifications

MCM and MIE
305 and 350 CID Engines

UNIT OF MEASUREMENT
in. (mm)



15297
MCM

87353
MIE
(Borg Warner
In-Line Trans.)

16482
5.7 Competition Ski
and 350 Magnum
Tournament Ski

49457
MIE
(Hurth 630A or
V-Drive Trans.)

Oil Pan

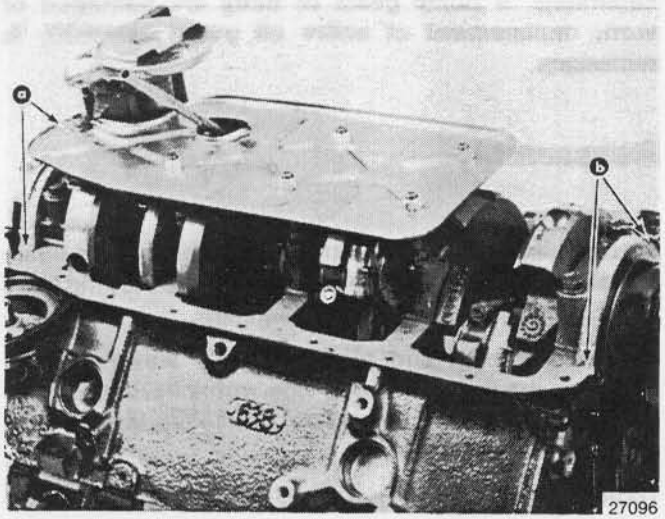
Removal

1. Drain crankcase oil.
2. Remove dipstick and tube.
3. Remove oil pan.

Installation

1. Clean sealing surfaces of engine block and oil pan.
2. Apply a small amount of RTV Sealer to joints (a) of rear seal retainer and joints (b) of front cover.

IMPORTANT: RTV Sealer sets up in about 15 minutes. Be sure to complete assembly promptly.



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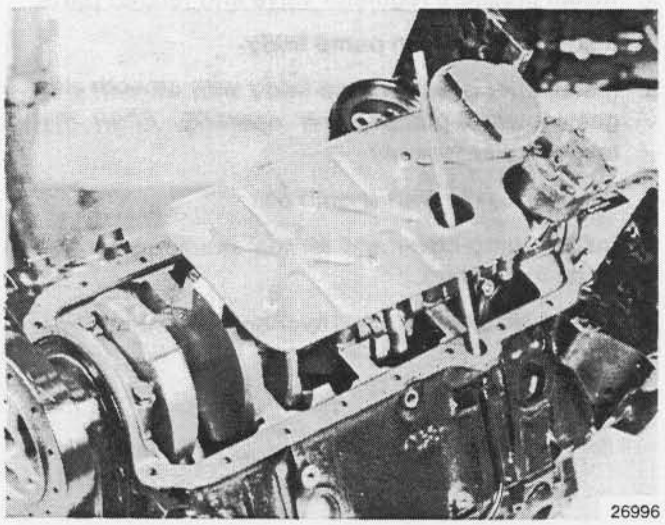
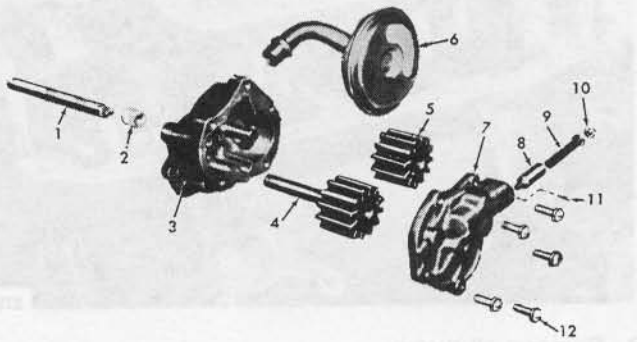
3. Install oil pan gasket in position as shown.


26996

4. Install oil pan. Starting from the center and working outward in each direction, tighten screws to 100 lb. in. (11 N·m). Tighten nuts to 200 lb. in. (22 N·m).
5. Install dipstick tube and dipstick.
6. Fill crankcase with oil.

Oil Pump



14446

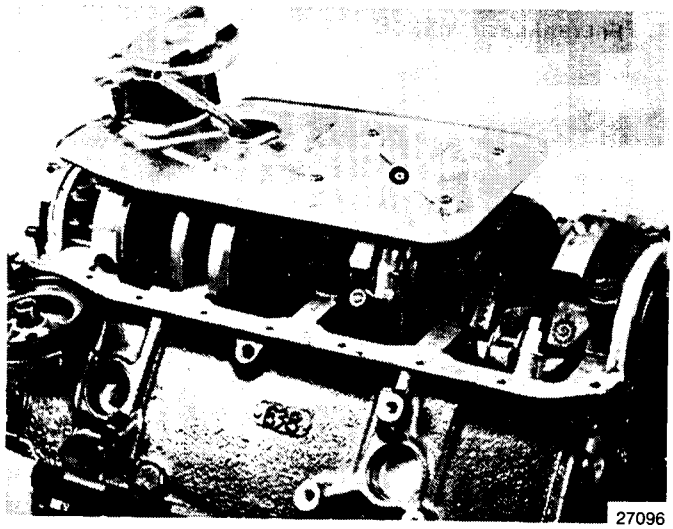
1 - Shaft Extension
2 - Shaft Coupling
3 - Pump Body
4 - Drive Gear and Shaft
5 - Idler Gear
6 - Pickup Screen and Pipe
7 - Pump Cover
8 - Pressure Regulator Valve
9 - Pressure Regulator Spring
10 - Washer
11 - Retaining Pin
12 - Screws

Oil Pump Assembly

The oil pump consists of 2 gears and a pressure regulator valve enclosed in a 2-piece housing. Oil pump is driven by distributor shaft which is driven by a helical gear on camshaft.

Removal

1. Remove oil pan as outlined.
2. Remove baffle (a).



3. Remove oil pump.

Disassembly

1. Remove pump cover.

IMPORTANT: Mark gear teeth for reassembly with same teeth indexing.

2. Remove idler gear and drive gear from pump body.
3. Remove retaining pin, spring, and pressure regulator valve from pump cover.

IMPORTANT: Do not remove pickup screen and pipe assembly, unless replacement is necessary. Loss of press fit condition could result in an air leak and loss of oil pressure.

IMPORTANT: Do not disturb pickup screen on pipe. This is serviced as an assembly.

4. If pickup screen and pipe assembly requires replacement, mount pump in a soft jawed vise and extract pipe from pump.

Cleaning and Inspection

1. Wash all parts in cleaning solvent and dry with compressed air.
2. Inspect pump body and cover for cracks or excessive wear.
3. Inspect pump gears for damage or excessive wear.
4. Check for loose drive gear shaft in pump body.
5. Inspect inside of pump cover for wear that would permit oil to leak past ends of gears.
6. Inspect pickup screen and pipe assembly for damage to screen or pipe.
7. Check pressure regulator valve for fit.

IMPORTANT: Pump gears and body are not serviced separately. If pump gears or body are damaged or worn, replacement of entire oil pump assembly is necessary.

Reassembly

⚠CAUTION

Be careful of twisting, shearing or collapsing pipe while installing in pump. Pickup screen must be parallel to oil pan bottom when oil pump is installed.

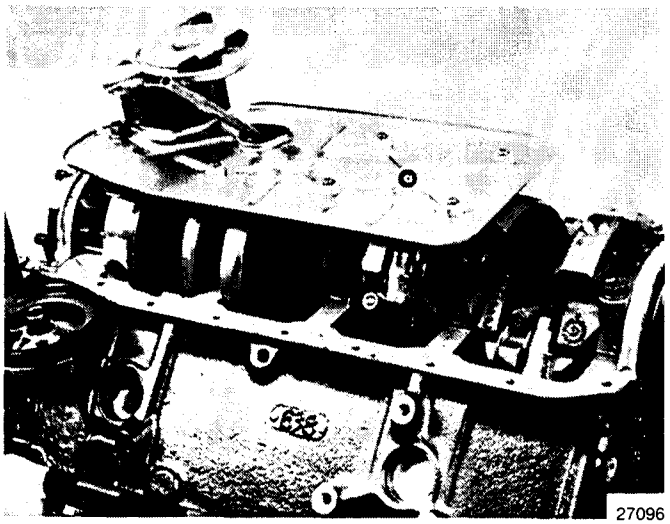
If pickup screen and pipe assembly was removed, mount pump in a soft-jawed vise, apply Perfect Seal to end of new pipe and using Tool (J-21882), tap the pipe in place with a hammer.

IMPORTANT: Oil internal parts liberally before installation.

1. Install pressure regulator valve and related parts.
2. Install drive gear in pump body.
3. Install idler gear in pump body with smooth side of gear toward pump cover opening. Align marks made in disassembly.
4. Fill gear cavity with engine oil.
5. Install pump cover and torque attaching screws to 80 lb. in. (9 N·m).
6. Turn drive shaft by hand to check for smooth operation.

Installation

1. Install pump, with extension shaft, to rear main bearing, aligning extension shaft with distributor drive shaft.
2. Install baffle (a). Tighten baffle nuts to 25 lb. ft. (34 N·m). Tighten oil pump bolt to 65 lb. ft. (88 N·m).


27096

3. Install oil pan as outlined.

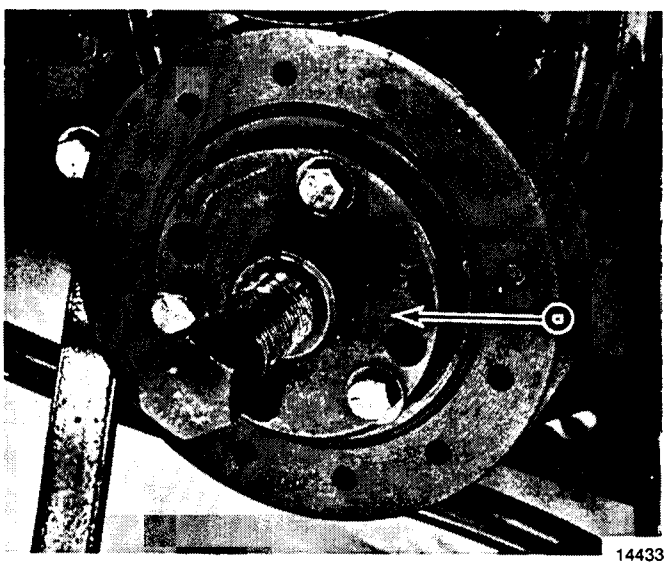
Harmonic Balancer

Removal

1. Remove drive belts.
2. Remove drive pulley, then remove harmonic balancer retaining bolt.

IMPORTANT: Do not use a universal claw type puller to remove harmonic balancer (in next step) as outside ring of harmonic balancer is bonded in rubber to the hub and use of claw type puller may break the bond.

3. Remove harmonic balancer with Tool J-23523-E (a).


14433

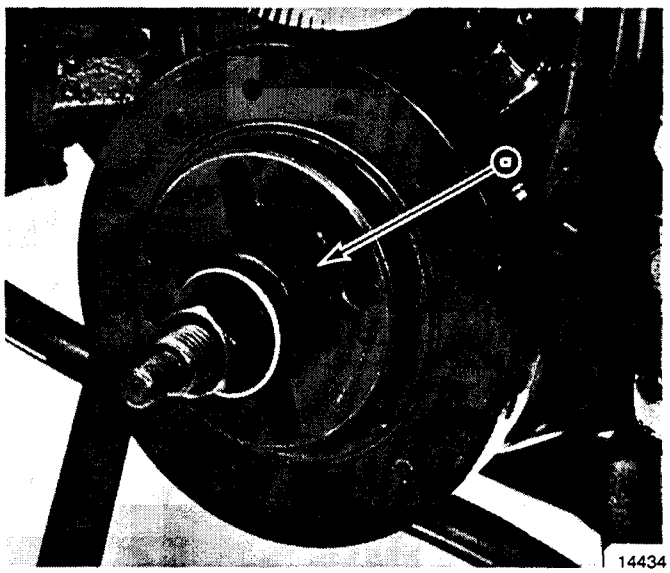
Installation

IMPORTANT: The inertia weight section of harmonic balancer is assembled to the hub with a rubber type material. The installation procedure (with proper tool) must be followed or movement of the inertia weight on the hub will destroy the tuning of the harmonic balancer.

1. Replace key in crankshaft if it is damaged.
2. Coat seal surface of harmonic balancer with engine oil.
3. Pull harmonic balancer onto crankshaft, using Tool J-23523-E as follows:
   a. Install appropriate end of threaded rod into crankshaft.

IMPORTANT: Be sure to install threaded rod in crankshaft at least 1/2 in. (13mm) to prevent damage to threads.

   b. Install plate, thrust bearing, washer and nut on rod.
   c. Pull harmonic balancer onto crankshaft by turning nut until it bottoms-out.


14434

a - Tool J-23523-E

   d. Remove tool from crankshaft.
   e. To prevent oil leakage, apply RTV sealant to harmonic balancer keyway.
   f. Install harmonic balancer bolt. Torque bolt on engines with stamped-steel crankshaft pulley [2-1/4 in. (57mm) long balancer bolt] to 60 lb. ft. (81.3 N·m). On engines with cast aluminum pulley [2-1/2 in. (63.5mm) long balancer bolt] torque bolt to 40 lb. ft. (54.2 N·m).
3. Install drive pulley(s). Torque bolts to 35 lb. ft. (48 N·m).
4. Install and adjust drive belts.

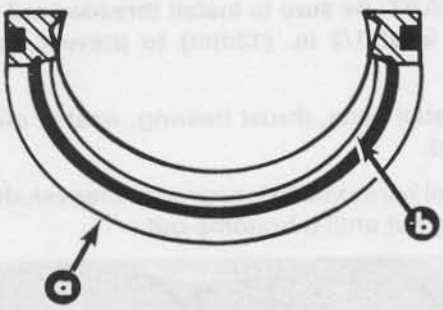
Crankcase Front Cover/ Oil Seal

Oil Seal Replacement (Without Removing Front Cover)

1. Remove harmonic balancer.
2. Pry seal out of cover from the front with a large screwdriver, being careful not to distort front cover or damage crankshaft.

Installation

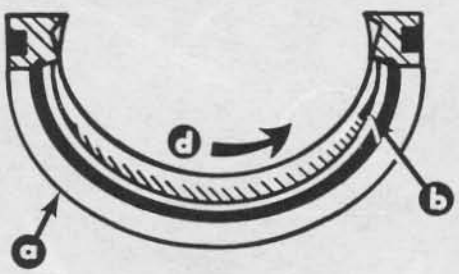
IMPORTANT: Correct rotation oil seal must be used to prevent oil leak.



50708

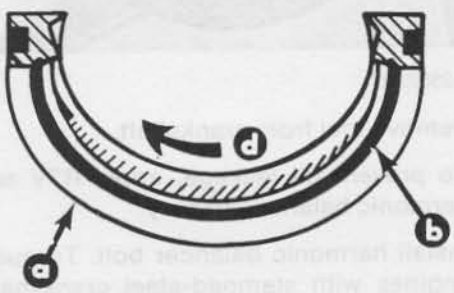
a - Can Be Used On Any Rotation Engine
b - Seal Lip Toward Inside of Engine

Front Seal WITHOUT Helical Grooves



50708

a - MCM and MIE (L.H.) Rotation Engines

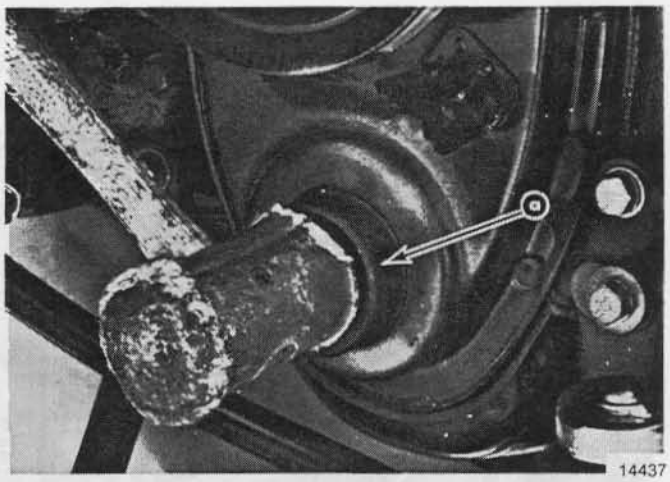


50708

b - MIE (R.H.) Rotation Engines
c - Seal Lip Toward Inside of Engine
d - Rotation of Crankshaft as Viewed From Flywheel End Looking Forward

Front Seals WITH Helical Grooves

3. Install new seal with open end of seal inward, using Tool J-35468. Drive seal in until it just bottoms out. Do not use excessive force.



14437

a - Tool J-35468

4. Reinstall harmonic balancer as outlined.

Crankcase Front Cover

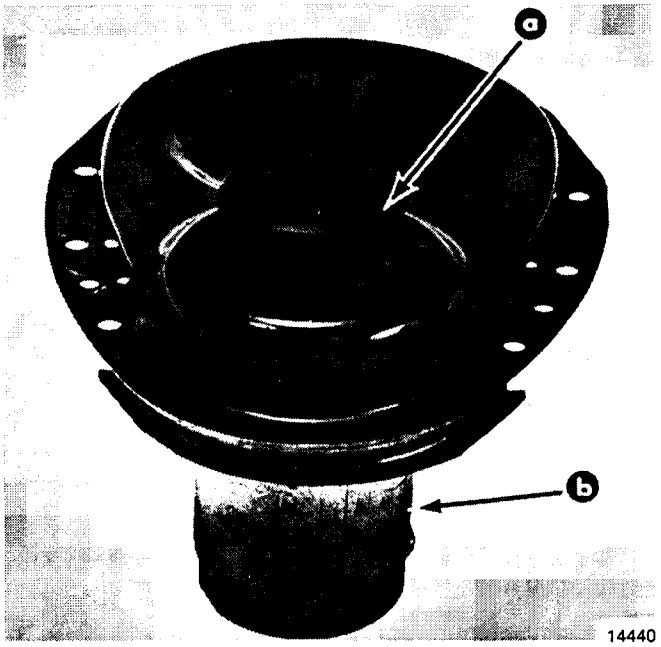
Removal

1. Remove engine from boat.
2. Remove harmonic balancer and oil pan.
3. Remove water circulating pump.
4. Remove crankcase front cover.
5. If damaged, drive oil seal out of front cover (from the rear) using a punch.

Installation

1. Clean front cover in solvent and dry with compressed air. Clean old gasket material and sealer from mating surfaces on cover and cylinder block. Check gasket surface on front cover for distortion and true if necessary. Surfaces must be clean and flat or oil leakage may result.

2. Install oil seal in cover with lip of seal toward inside of engine, using Tool J-35468. Support cover around seal area with appropriate tool as shown.



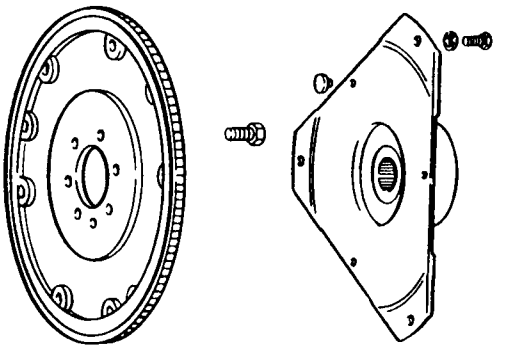
a - Tool J-35468
b - Support (To Prevent Distorting Cover)

3. Coat both sides of front cover gasket with Perfect Seal and place in position on engine.
4. Install front cover, making sure holes in cover align with dowel pins in block. Torque front cover attaching screws to 100 lb. in. (11 N·m).
5. Install oil pan and harmonic balancer as outlined.
6. Install water circulating pump.
7. Reinstall engine in boat.
8. Fill crankcase with engine oil.
9. Start engine and check for water and oil leaks.

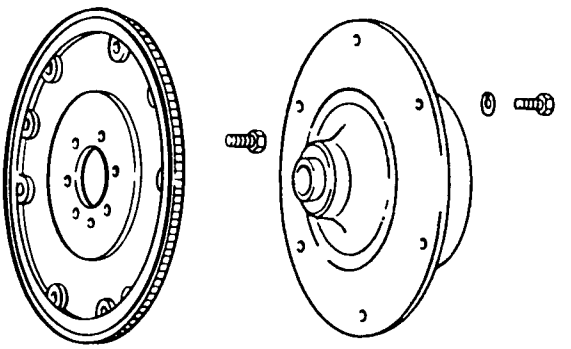
Flywheel

Removal

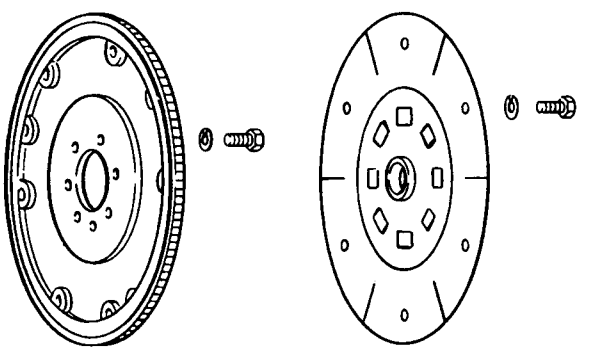
1. Remove engine from boat.
2. Remove transmission, if so equipped.
3. Remove flywheel housing and related parts.
4. Remove MCM coupler or MIE drive plate.
5. Remove flywheel.



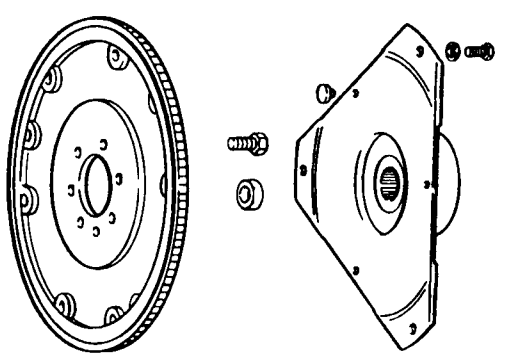
Alpha One Couplers



5.7 Litre Bravo Coupler



MIE Drive Plate



Jack Shaft Coupler

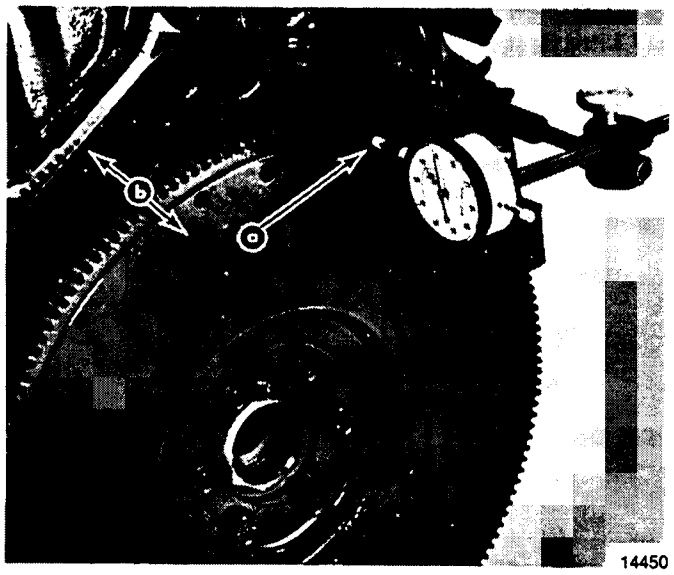
Inspection

1. Inspect splines in drive plate or coupler for wear.
2. Check flywheel ring gear for worn or missing teeth.

Installation

NOTE: If crankshaft is to be replaced, but old pilot bushing is to be reused, bushing can be removed without damage by filling pilot bushing cavity with grease, then, inserting an old transmission input shaft in bore of bushing and hitting it with a hammer. This will create hydraulic pressure in pilot bushing cavity which should force bushing out.

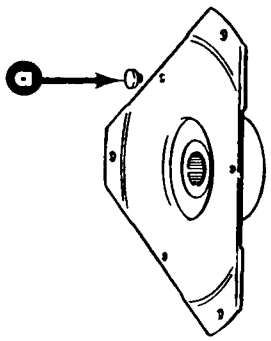
1. Clean mating surfaces of flywheel and crankshaft. Remove any burrs.
2. Aligning dowel hole in flywheel with dowel in crankshaft, install flywheel. Torque bolts to 75 lb. ft. (100 N·m).
3. Check flywheel runout as follows:
   a. Attach a dial indicator to engine block.
   b. Take readings around outer edge of flywheel. Push in on flywheel to remove crankshaft end play.
   c. Maximum runout - .008 in. (.203mm).



a - .008 in. (.203mm) Max. Runout
b - Push Flywheel and Crankshaft Forward As Far As It Will Go When Taking Reading

Checking Flywheel Runout

IMPORTANT: Insert 3 rubber bumpers (a) in Alpha coupler before installation on flywheel.



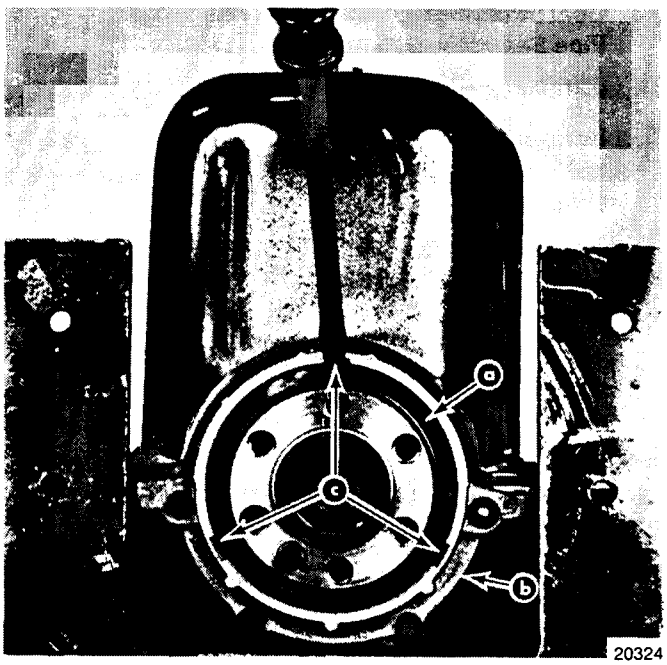
4. Install drive coupler or drive plate. Torque bolts to 35 lb. ft. (48 N·m).
5. Install flywheel housing and related parts. Torque bolts to 30 lb. ft. (41 N·m).
6. Install flywheel housing cover. Torque bolts to 80 lb. in. (9 N·m).
7. Install transmission (MIE). Torque bolts to 50 lb. ft. (68 N·m).

Rear Main Oil Seal

The rear crankshaft oil seal can be replaced without removing the oil pan or rear main bearing cap from engine.

Removal

1. Remove seal by using a screwdriver to pry it out of retainer as shown.



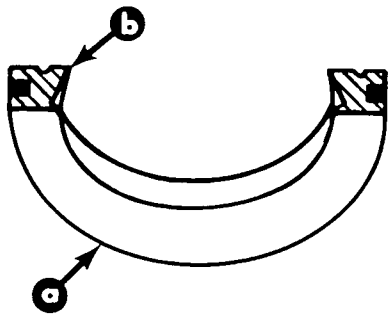
20324

a - Rear Seal
b - Seal Retainer
c - Slots (Three)

2. Clean crankshaft/seal running surface and seal retainer.

Installation

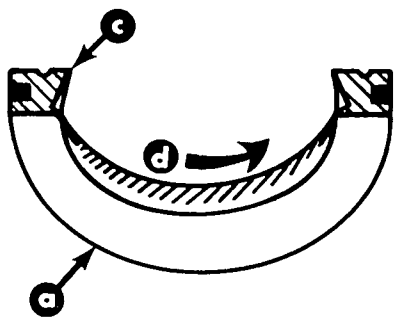
IMPORTANT: Correct rotation oil seal must be used to prevent oil leak.



50708

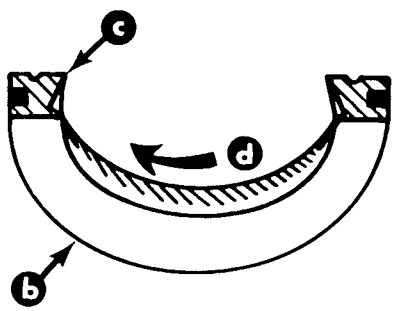
a - Can Be Used On Any Rotation Engine
b - Sealed Lip Toward Inside of Engine

Rear Seal WITHOUT Helical Grooves



50708

a - MCM and MIE (L.H.) Rotation Engines



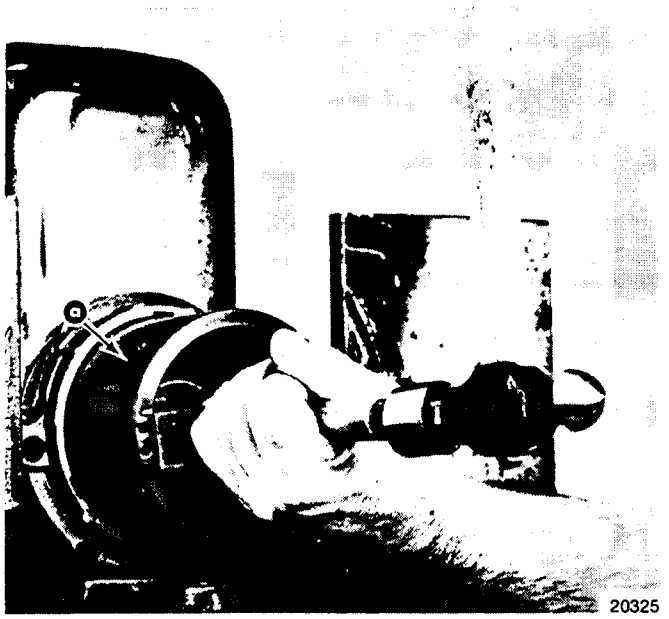
50708

b - MIE (R.H.) Rotation Engines
c - Seal Lip Toward Inside of Engine
d - Rotation of Crankshaft as Viewed From Flywheel End Looking Forward

Rear Seals WITH Helical Grooves

Installation

1. Apply Perfect seal to seal retainer mating surface. Apply grease to seal lips.
2. Install seal using tool J-26817-A.



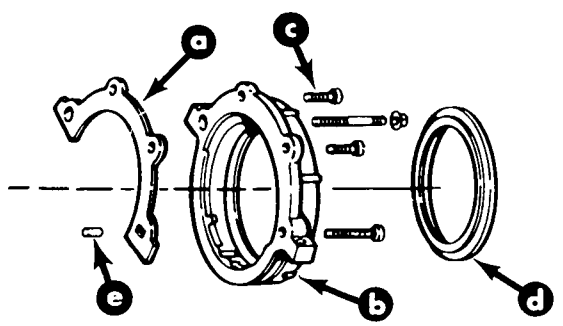
a - Tool J-26817-A

Rear Main Oil Seal Retainer

IMPORTANT: Rear Main Oil Seal Retainers appear similar but are engine specific; refer to Parts Manual and order the proper retainer for your engine when replacing.

Removal

1. Remove oil pan and flywheel as outlined in this SECTION 3A.
2. Remove oil seal retainer fasteners. Carefully remove oil seal retainer from engine block.



a - Oil Seal Retainer Gasket
b - Oil Seal Retainer
c - Fasteners
d - Rear Main Oil Seal
e - Alignment Dowel Pin

Cleaning and Inspection

1. Clean old gasket material from mating surfaces.
2. Inspect oil seal retainer for cracks or scored surface.
3. Inspect alignment pin in engine block for damage; replace if necessary.
4. Inspect oil seal for worn, dry or torn sealing surface. Replace if necessary. (Refer to "Rear Main Oil Seal" as previously outlined.)

Installation

1. Coat seal lips with clean 30W motor oil.
2. Install gasket and oil seal retainer with rear main seal.
3. Coat threads of oil seal retainer fasteners with Loctite Pipe Sealant with teflon.
4. Install fasteners and torque to 133 lb. in. (19 N·m).
5. Install oil pan and fasteners. Torque 1/4 in.-20 screws to 80 lb. in. (9 N·m) and 5/16 in.-18 screws to 165 lb. in. (19 N·m).

NOTE: A one-piece oil pan gasket may be reused if it is still pliable and is not cracked, torn, or otherwise damaged.

Main Bearings

IMPORTANT: Before removing main bearing caps or connecting rod caps, mark them for reassembly in their original locations.

Main bearings are of the precision insert type and do no utilize shims for adjustment. If clearances are found to be excessive, a new bearing, both upper and lower halves, will be required. Service bearings are available in standard size and .001 in., .010 in. and .020 in. undersize.

Selective fitting of both rod and main bearing inserts is necessary in production in order to obtain close tolerances. For this reason you may find one half of a standard insert with one half of a .001 in. undersize insert which will decrease the clearance .0005 in. from using a full standard bearing.

When a production crankshaft cannot be precision fitted by this method, it is then ground .009 in. undersize ON ONLY THOSE MAIN JOURNALS THAT CANNOT BE PROPERLY FITTED. ALL JOURNALS WILL NOT NECESSARILY BE GROUND UNDERSIZE. A .009 in. undersize bearing and .010 in. undersize bearing may be used for precision fitting in the same manner as previously described.

Inspection

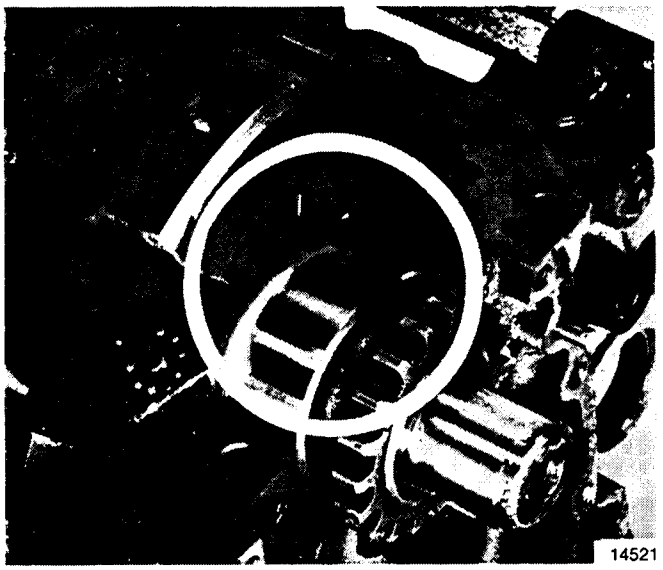
In general, the lower half of the bearing (except #1 bearing) shows a greater wear and the most distress from fatigue. If upon inspection the lower half is suitable for use, it can be assumed that the upper half is also satisfactory. If the lower half shows evidence of wear or damage, both upper and lower halves should be replaced. Never replace one half without replacing the other half.

Checking Clearance

To obtain accurate measurements while using "Plastigage," or its equivalent, engine must be out of the boat and upside down so crankshaft will rest on the upper bearings and total clearance can be measured between lower bearing and journal.

To assure the proper seating of the crankshaft, all bearing cap bolts should be at their specified torque. In addition, preparatory to checking fit of bearings, the surface of the crankshaft journal and bearing should be wiped clean of oil.

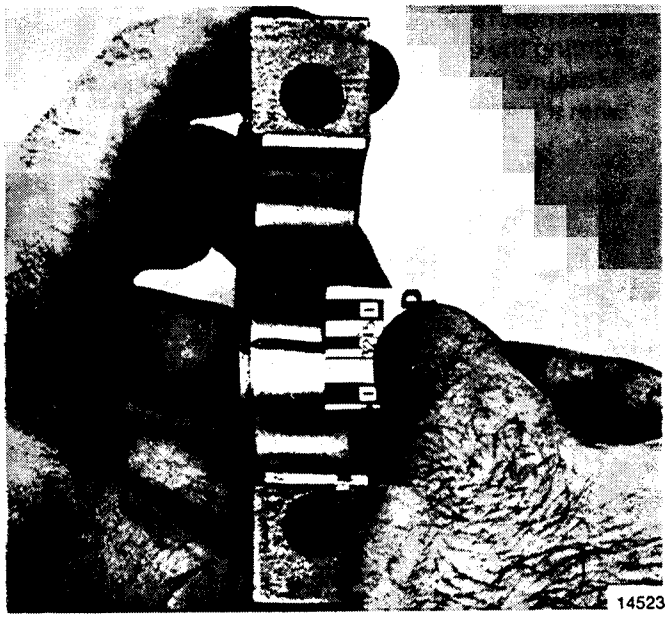
1. With the oil pan and oil pump removed, and starting with the rear main bearing, remove bearing cap and wipe oil from journal and bearing cap.
2. Place a piece of gaging plastic the full width of the bearing (parallel to the crankshaft) on the journal as shown.


14521

Gauging Plastic on Journal

NOTICE: Do not rotate the crankshaft while the gaging plastic is between the bearing and journal.

3. Install the bearing cap and evenly torque the retaining bolts to specifications. Bearing cap MUST be torqued to specification in order to assure proper reading. Variations in torque affect the compression of the plastic gage.
4. Remove bearing cap. The flattened gaging plastic will be found adhering to either the bearing shell or journal.
5. On the edge of the gaging plastic envelope there is a graduated scale which is correlated in thousandths of an inch. Without removing the gaging plastic, measure its compressed width (at the widest point) with the graduations on the gaging plastic envelope as shown.

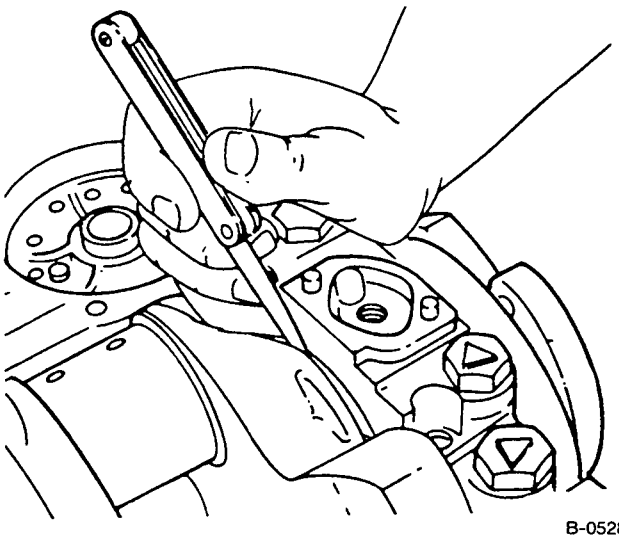

14523

Measuring Gauging Plastic

NOTE: Normally main bearing journals wear evenly and are not out-of-round. However, if a bearing is being fitted to an out-of-round journal (.001 in. max.), be sure to fit to the maximum diameter of the journal: If the bearing is fitted to the minimum diameter, and the journal is out-of-round .001 in., interference between the bearing and journal will result in rapid bearing failure. If the flattened gaging plastic tapers toward the middle or ends, there is a difference in clearance indicating taper, low spot or other irregularity of the bearing or journal. Be sure to measure the journal with a micrometer if the flattened gaging plastic indicates more than .001 in. difference.

6. If the bearing clearance is within specifications, the bearing insert is satisfactory. If the clearance is not within specifications, replace the insert. Always replace both upper and lower insert as a unit.
7. A standard, or .001 in., undersize bearing may produce the proper clearance. If not, it will be necessary to regrind the crankshaft journal for use with the next undersize bearing.
   After selecting new bearing, recheck clearance.

8. Proceed to the next bearing. After all bearings have been checked, rotate the crankshaft to see that there is no excessive drag.
   When checking #1 main bearing, loosen accessory drive belts so as to prevent tapered reading with plastic gage.
9. Measure crankshaft end play (see specifications) by forcing the crankshaft to the extreme front position. Measure at the front end of the rear main bearing with a feeler gage as shown.



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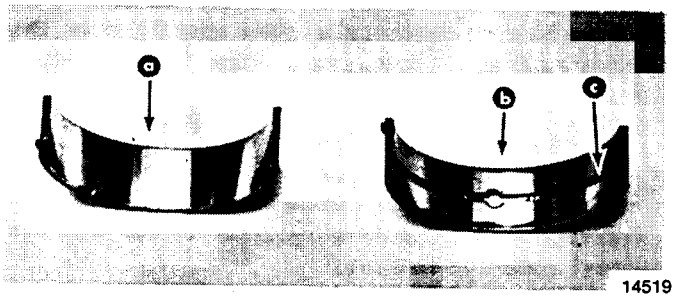
NOTE: Some engines may come with rear main bearings that the distance between thrust faces is .008 in. wider than standard. The crankshaft will be identified by .008 in. stamped on the rear counterweight. If rear main bearings are replaced, they must have the proper distance between thrust faces to achieve correct crankshaft end play.

Replacement

NOTE: Main bearings may be replaced with or without removing crankshaft.



14519

a - Lower Bearing Insert (Install in Cap)
b - Upper Bearing Insert (Install in Block)
c - Oil Groove

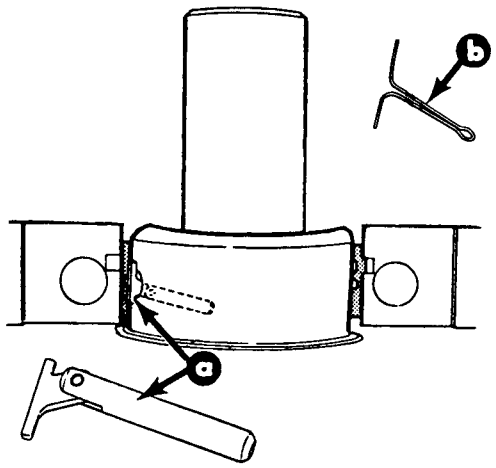
Main Bearing Inserts

WITH CRANKSHAFT REMOVED

1. Remove and inspect the crankshaft as outlined.
2. Remove the main bearings from the cylinder block and main bearing caps.
3. Coat bearing surfaces of new, correct size, main bearings with oil and install in the cylinder block and main bearing caps.
4. Install the crankshaft.

WITHOUT CRANKSHAFT REMOVED

1. With oil pan, oil pump and spark plugs removed, remove cap on main bearing requiring replacement and remove bearing from cap.
2. Install main bearing removing and installing tool J-8080 in oil hole in crankshaft journal. If such a tool is not available, a cotter pin may be bent, as shown, to do the job.



50764

a - Tool J-8080
b - Cotter Pin

3. Rotate the crankshaft clockwise as viewed from the front of engine. This will roll upper bearing out of block.
4. Oil new selected size upper bearing and insert plain (unnotched) end between crankshaft and indented or notched side of block. Rotate the bearing into place and remove tool from oil hole in crankshaft journal.
5. Oil new lower bearing and install in bearing cap.
6. Install main bearing cap with arrows pointing toward front of engine.
7. Torque all main bearing caps, EXCEPT THE REAR MAIN CAP, to 80 lb. ft. (109 N·m). Torque rear main bearing cap to 10-12 lb. ft. (14-16 N·m) then tap end of crankshaft, first rearward then forward with a lead hammer. This will line up rear main bearing and crankshaft thrust surfaces. Torque rear main bearing cap to 80 lb. ft. (109 N·m).

Connecting Rod Bearings

Connecting rod bearings are of the precision insert type and do not utilize shims for adjustment. DO NOT FILE RODS OR ROD CAPS. If clearances are found to be excessive, a new bearing will be required. Service bearings are available in standard size and .001 in. and .002 in. undersize for use with new and used standard size crankshafts, and in .010 in. and .020 in. undersize for use with reconditioned crankshafts.

On removing a connecting rod cap, it is possible to find a .010 in. undersize bearing. These are used in manufacturing for selective fitting.

Inspection and Replacement

1. With oil pan and oil pump removed, remove the connecting rod cap and bearing.
   Before removal of connecting rod cap, mark the side of the rod and cap with the cylinder number to assure matched reassembly of rod and cap.
2. Inspect the bearing for evidence of wear or damage. (Bearings showing the above should not be installed.)
3. Wipe both upper and lower bearing shells and crankpin clean of oil.
4. Measure the crankpin for out-of-round or taper with a micrometer. If not within specifications, replace or recondition the crankshaft. If within specifications and a new bearing is to be installed, measure the maximum diameter of the crankpin to determine new bearing size required.
5. If within specifications measure new or used bearing clearances with Plastigage or its equivalent.
   If a bearing is being fitted to an out-of-round crankpin, be sure to fit to the maximum diameter of the crankpin. If the bearing is fitted to the minimum diameter, and the crankpin is out-of-round .001 in., interference between the bearing and crankpin will result in rapid bearing failure.

a. Place a piece of gaging plastic, the length of the bearing (parallel to the crankshaft), on the crankpin or bearing surface as shown. Plastic gage should be positioned in the middle of the bearing shell. (Bearings are eccentric and false readings could occur if placed elsewhere).

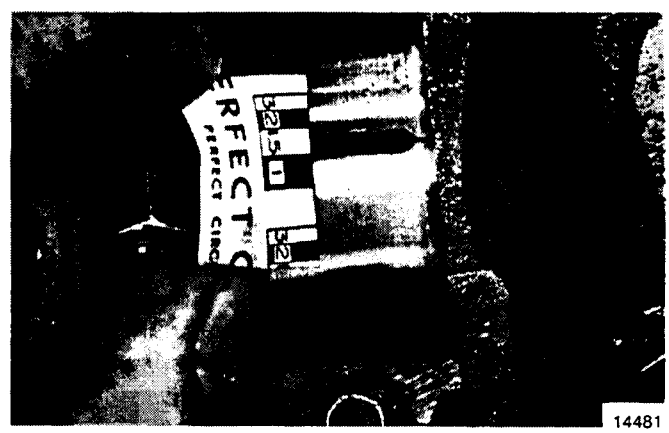
Gaging Plastic on Crankpin

b. Install the bearing in the connecting rod and cap.

c. Install the bearing cap and evenly torque nuts to 45 lb. ft. (61 N·m).

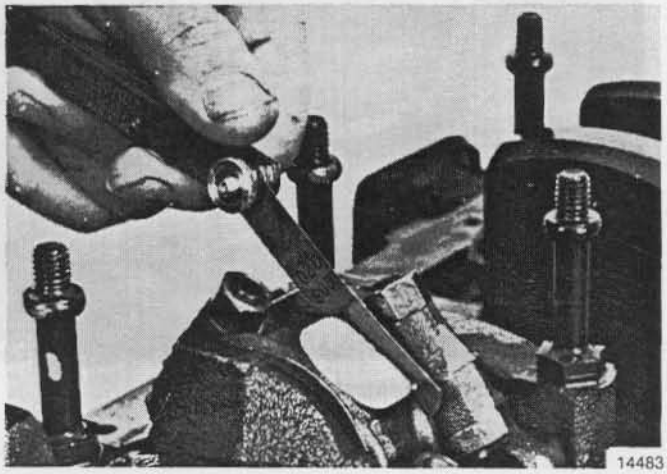
NOTICE: Do not turn the crankshaft with the gaging plastic installed.

d. Remove the bearing cap and using the scale on the gaging plastic envelope, measure the gaging plastic width at the widest point as shown.



Measuring Gauging Plastic

6. If the clearance exceeds specifications, select a new, correct size, bearing and remeasure the clearance.
   Be sure to check what size bearing is being removed in order to determine proper replacement size bearing. If clearance cannot be brought to within specifications, the crankpin will have to be ground undersize. If the crankpin is already at maximum undersize, replace crankshaft.
7. Coat the bearing surface with oil, install the rod cap and torque nuts to 45 lb. ft. (61 N·m).
8. When all connecting rod bearings have been installed, tap each rod lightly (parallel to the crankpin) to make sure they have clearance.
9. Measure all connecting rod side clearances (see specifications) between connecting rod caps as shown.


14483

Connecting Rod/Piston Assembly

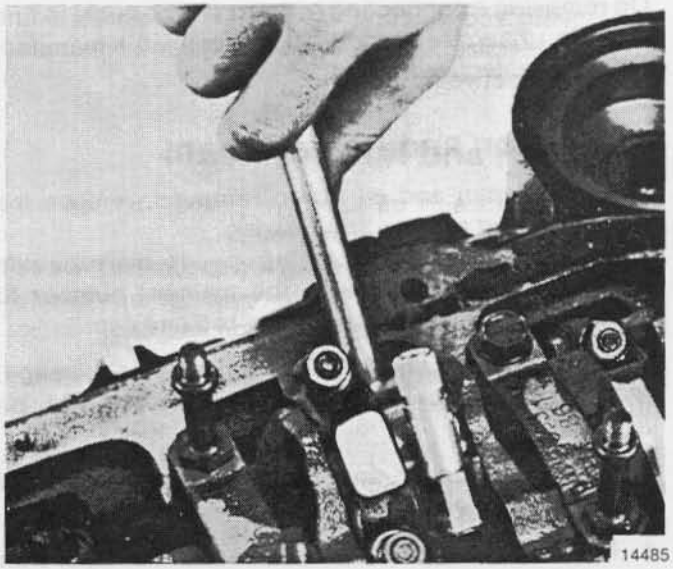
Removal

1. Remove as outlined:
   a. oil pan and dipstick tube
   b. baffle and oil pump
   c. distributor and intake manifold
   d. cylinder heads
2. Use a ridge reamer to remove any ridge and/or deposits from upper end of cylinder bore.

IMPORTANT: Before ridge and/or deposits are removed, turn crankshaft until piston is at bottom of stroke and place a cloth on top of piston to collect cuttings. After ridge and/or deposits are removed, turn crankshaft until piston is at top of stroke, then remove cloth and cuttings.

3. Mark connecting rods and bearing caps (left bank 1, 3, 5 and 7; right bank 2, 4, 6 and 8 from front to rear on same side as piston thrust).
4. Remove connecting rod cap and install tool J-5239 (3/8") on bolts. Push connecting rod and piston assembly out of top of cylinder block.

NOTE: It will be necessary to turn crankshaft slightly to disconnect and remove some connecting rod and piston assemblies.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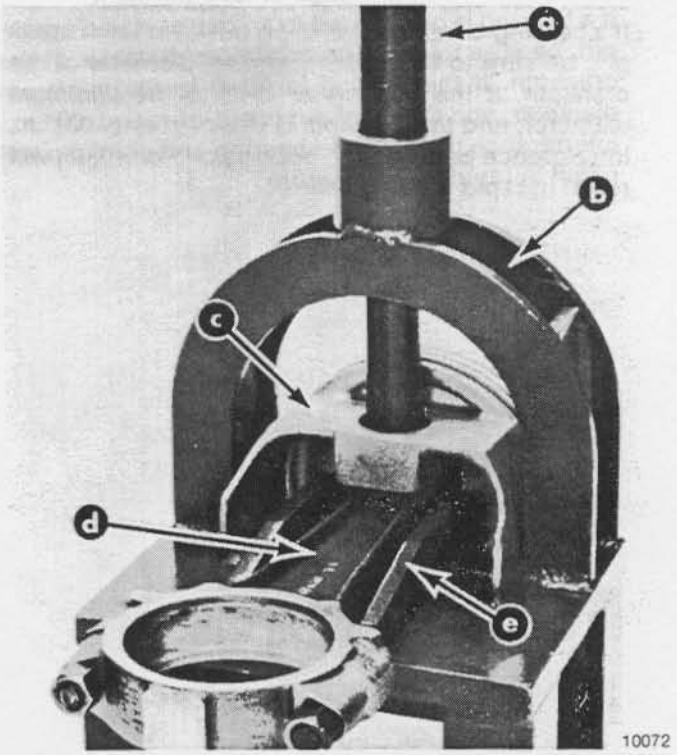
Removing Piston Assembly

Disassembly

Disassemble piston from connecting rod using Kit J-24086-B as shown. Follow instructions supplied with kit.



10072

Cleaning and Inspection

CONNECTING RODS

1. Wash connecting rods in cleaning solvent and dry with compressed air.
2. Check for twisted or bent rods and inspect for nicks or cracks. Replace damaged connecting rods.

PISTONS

NOTE: Cylinder bore and taper must be within specifications before pistons can be considered for reuse.

1. Clean varnish from piston skirts with a cleaning solvent. DO NOT WIRE BRUSH ANY PART OF PISTON. Clean ring grooves with a groove cleaner and make sure oil ring holes are clean.
2. Inspect piston for cracked ring lands, skirts or pin bosses, wavy worn ring lands, scuffed or damaged skirts or eroded areas at top of piston. Replace pistons which are damaged or show signs of excessive wear.
3. Inspect grooves for nicks or burrs that might cause rings to hang up.
4. Measure piston skirt and check clearance as outlined under "Piston Selection."
5. Slip outer surface of a new top and second compression ring into respective piston ring groove and roll ring entirely around the groove to make sure that ring is free as shown. If binding occurs at any point, determine cause. If caused by ring groove, remove by dressing with a fine cut file. If binding is caused by a distorted ring, recheck with another ring.

Rolling Ring in Ring Groove

6. Proper clearance of piston ring in its piston ring groove is very important to provide proper ring action and reduce wear. Therefore, when fitting new rings, clearances between ring and groove surfaces should be measured. See "Specifications".

Checking Groove Clearance

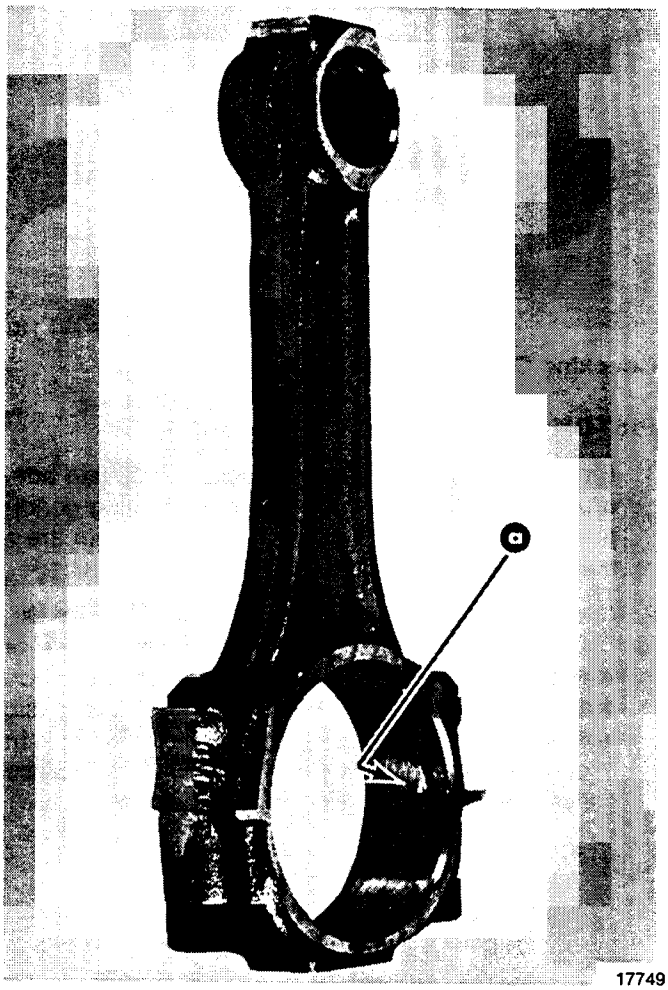
PISTON PINS

1. Piston pin clearance is designed to maintain adequate clearance under all engine operating conditions. Because of this, piston and piston pin are a matched set and not serviced separately.
2. Inspect piston pin bores and piston pins for wear. Piston pin bores and piston pins must be free of varnish or scuffing when measured. Measure piston pin with a micrometer and piston pin bore with a dial bore gauge or inside micrometer. If clearance is in excess of the .001 in. (.025mm) wear limit, replace piston and piston pin assembly.

Reassembly

IMPORTANT: When reassembling pistons and connecting rods, the following must be kept in mind.

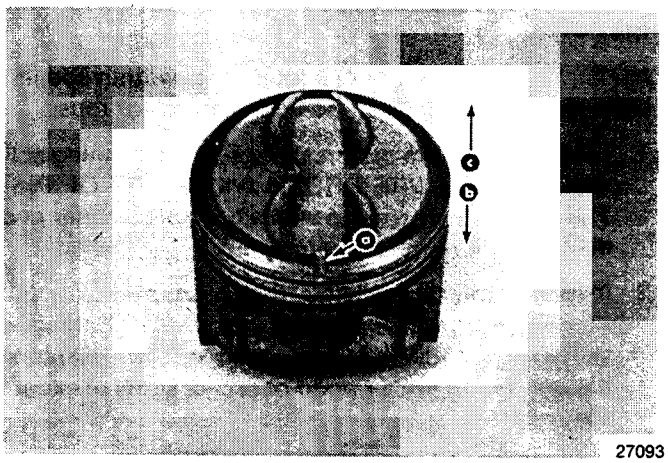
- **Piston and pin are machine fitted to each other and must remain together as a matched set. Do not intermix pistons and pins.**
- **If original pistons and/or connecting rods are being used, be sure to assemble pistons and connecting rods so they can be reinstalled in same cylinder from which they were removed.**
- **Connecting rod bearing tangs (a) are always toward outside of cylinder block.**



a - Connecting Rod Bearing Tangs Must Face Toward Outside of Cylinder Block

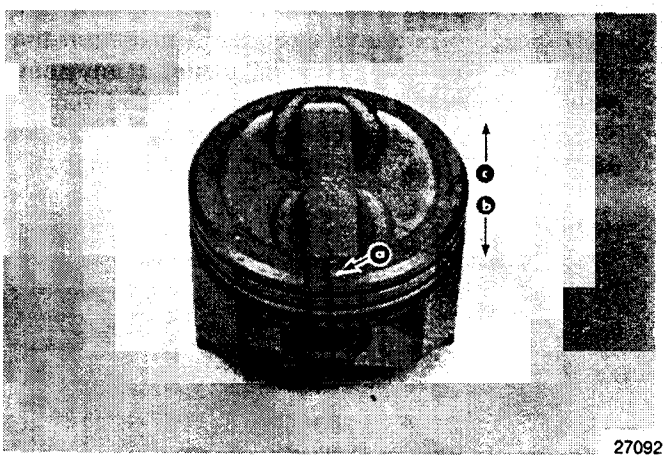
Connecting Rod

- **To determine if engine is left-hand (standard) rotation or right-hand (opposite) rotation, inspect camshaft drive. If engine has a timing chain, engine is left-hand rotation. If engine has timing gears, engine is right-hand rotation. All MCM engines are left-hand rotation.**
- **Notch (a) on piston, must be positioned correctly for engine that is being repaired.**



a - Notch
b - MCM and MIE L.H. Rotation Engines - Notch Toward Front of Engine
c - MIE R.H. Rotation Engines - Notch Toward Rear of Engine

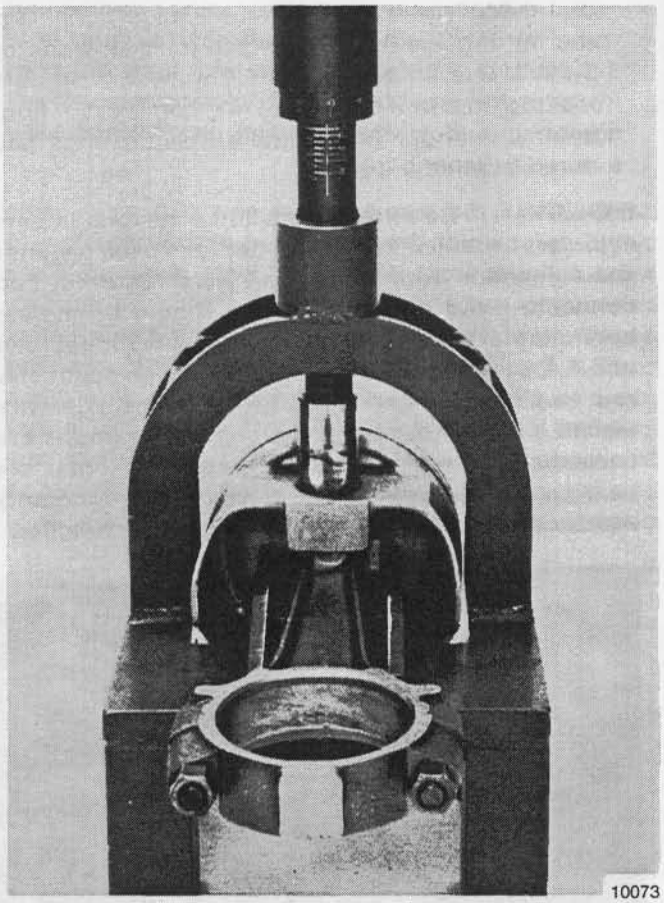
5.0 Litre (305 CID) Engines



a - Notch
b - MCM and MIE L.H. Rotation Engines - Notch Toward Front of Engine
c - MIE R.H. Rotation Engines - Notch Toward Rear of Engine

5.7 Litre (350 CID) Engines

1. Assemble piston to connecting rod using Kit J-24086-B as shown. Follow instructions supplied with kit.



10073

Installing Piston Pin

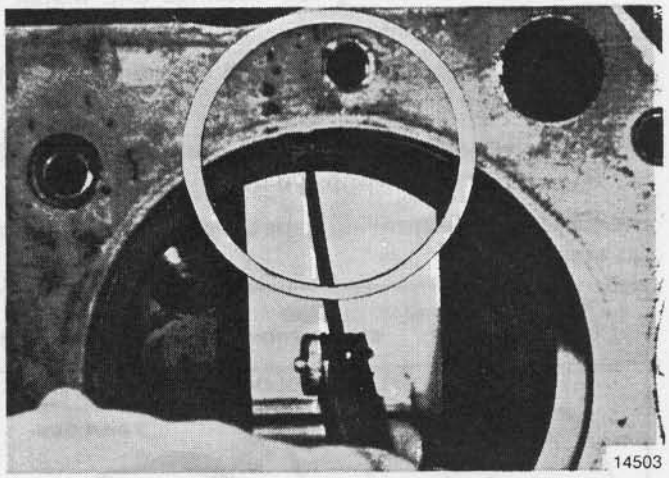
2. Once assembled, check piston for freedom of movement (back-and-forth and up-and-down) on connecting rod. Piston should move freely in all directions. If it does not, piston pin bore is tight and piston/pin assembly must be replaced.
3. If a new connecting rod has been installed, mark connecting rod and cap (on side of rod and cap with slots for connecting rod bearing tangs) with cylinder number in which it will be installed.

PISTON RINGS

All compression rings are marked on upper side of ring. When installing compression rings, make sure that marked side is toward top of piston.

Oil control rings are a 3-piece type, consisting of 2 rings and a spacer.

1. Select rings comparable in size to cylinder bore and piston size.
2. Slip compression ring in cylinder bore, then press ring down into cylinder bore about 1/4 in. (6mm) (below ring travel). Be sure that ring is square with cylinder wall.
3. Measure gap between ends of ring with a feeler gauge as shown.



14503

Checking Ring Gap

4. If gap between ends of ring is below specifications, remove ring and try another for fit.
5. Fit each compression ring to cylinder in which it is going to be used.
6. Clean and inspect pistons, if not previously done.
7. Install piston rings as follows:
   a. Install oil ring spacer in groove and insert anti-rotation tang in oil hole.
   b. Hold spacer ends butted and install lower steel oil ring rail with gap properly located.
   c. Install upper steel oil ring rail with gap properly located.
   d. Flex the oil ring assembly to make sure ring is free. If binding occurs at any point, the cause should be determined and, if caused by ring groove, remove by dressing groove with a fine cut file. If binding is caused by a distorted ring, check a new ring.

IMPORTANT: Use 91-24697 piston ring expander for compression ring installation.

e. Install lower compression ring, using ring expander.

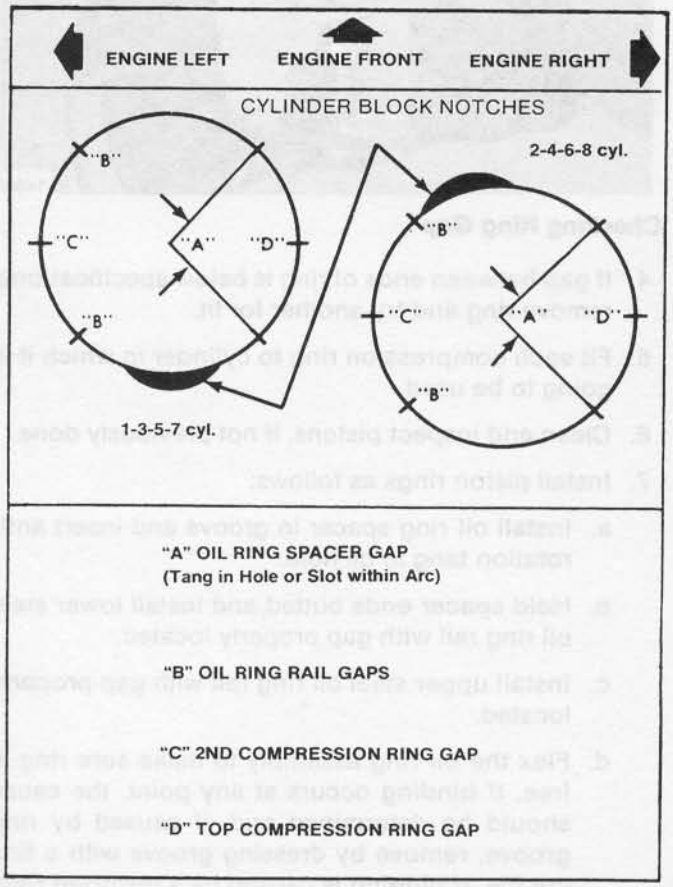
f. Install top compression ring, using ring expander.

Installation

IMPORTANT: Cylinder bores must be clean before piston installation. Clean with a light honing, as necessary. Then clean with hot water and detergent wash. After cleaning, swab bores several times with light engine oil and a clean cloth, then wipe with a clean dry cloth.

1. Lubricate connecting rod bearings and install in rods and rod caps.
2. Lightly coat pistons, rings and cylinder walls with light engine oil.
3. With bearing caps removed, install tool J-5239 (3/8 in.) on connecting rod bolts.

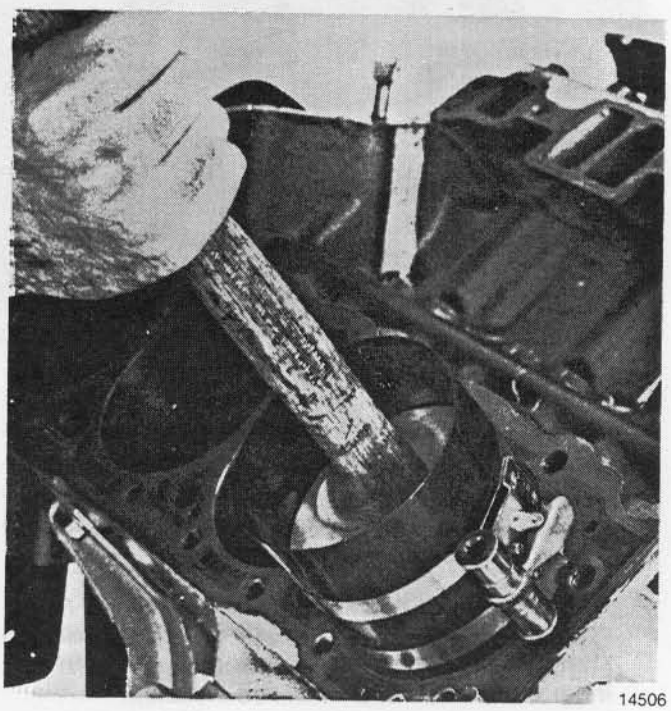
IMPORTANT: Be sure ring gaps are properly positioned as shown.



Ring Gap Location

4. Install each connecting rod and piston assembly in its respective bore. Install with connecting rod bearing tangs toward outside of cylinder block. Use tool J-8037 to compress rings. Guide connecting rod into place on crankshaft journal with tool J-5239. Use a hammer handle with light blows to install piston into bore. Hold ring compressor firmly against cylinder block until all piston rings have entered cylinder bore.

IMPORTANT: Be sure to install new pistons in same cylinders for which they were fitted, and used pistons in same cylinder from which they were removed. Each connecting rod and bearing cap should be marked, beginning at front of engine (1, 3, 5 and 7 in left bank and 2, 4, 6 and 8 in right bank). Numbers on connecting rod and bearing cap must be on same side when installed in cylinder bore. If a connecting rod is ever transposed from one block or cylinder to another, new bearings should be fitted and connecting rod should be numbered to correspond with new cylinder number.



Installing Connecting Rod and Piston Assemblies

5. Remove tool J-5239.
6. Install bearing caps and torque nuts to 45 lb. ft. (61 N·m).
7. Check connecting rod side clearance.

NOTE: If bearing replacement is required, refer to "Connecting Rod Bearings."

8. Install as previously outlined:
   a. oil pump and baffle
   b. dipstick and oil pan
   c. cylinder heads
   d. intake manifold
   e. distributor
9. Fill crankcase with oil.
10. Adjust valves as outlined under "Valve Adjustment - Engine Stopped."

Crankshaft

Removal

1. Remove engine from boat.
2. Drain crankcase oil.
3. Remove as outlined:
   a. starter
   b. flywheel housing
   c. drive coupler/plate and flywheel
   d. belts
   e. water pump
   f. crankshaft pulley and harmonic balancer
   g. spark plugs
   h. oil pan and dipstick tube
   i. baffle and oil pump
   j. timing chain/gear cover
4. Turn crankshaft to align timing mark with camshaft mark.
5. Remove camshaft sprocket or gear.
6. Remove rear main seal and retainer.
7. Make sure all bearing caps (main and connecting rods) are marked so they can be reinstalled in their original locations.
8. Remove connecting rod bearing caps, then push piston and rod assemblies toward heads.
9. Remove main bearing caps and carefully lift crankshaft out of cylinder block.
10. If new main and/or connecting rod bearings are to be installed, remove main bearing inserts from cylinder block and bearing caps, and/or connecting rod bearing inserts from connecting rod and caps. Install new bearings following procedures outlined.

Cleaning and Inspection

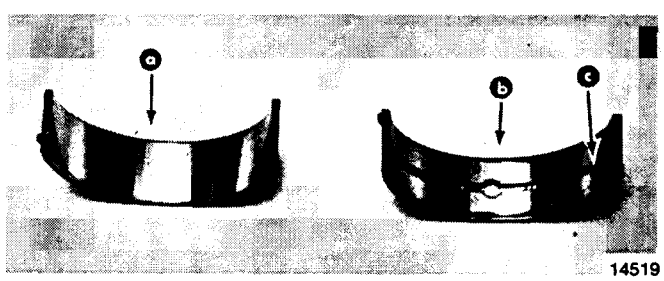
1. Wash crankshaft in solvent and dry with compressed air.
2. Measure main bearing journals and crankpin dimensions with a micrometer for out-of-round, taper or undersize (see "Specifications").
3. Check crankshaft for runout (by supporting at front and rear main bearings journals in "V" blocks) and check at front and rear intermediate journals with a dial indicator (see "Specifications").
4. Replace or recondition crankshaft if not within specifications.

Installation

1. If a new crankshaft is being installed, proceed as follows:
   a. Remove timing sprocket or gear from old crankshaft and reinstall on new crankshaft as outlined.
   b. On jackshaft models, if old pilot bushing is to be reused, bushing can be removed without damage by filling pilot bushing cavity with grease, then, inserting an old transmission input shaft in bore of bushing and hitting it with a hammer. This will create hydraulic pressure in pilot bushing cavity which should force bushing out.

IMPORTANT: Be sure that all bearings and crankshaft journals are clean.

2. Install main bearings in engine block - refer to photo.



a - Lower Bearing Insert (Install in Cap)
b - Upper Bearing Insert (Install in Block)
c - Oil Groove

Main Bearing Inserts

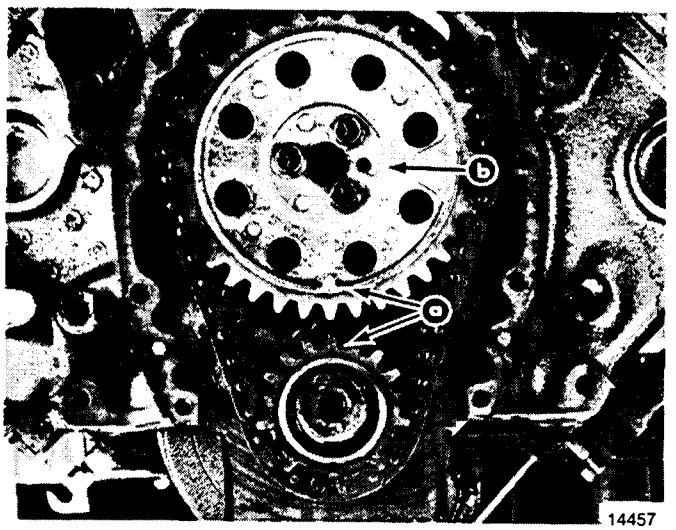
3. Carefully lower crankshaft into place. Be careful not to damage bearing surface.
4. Check clearance of each main bearing, following procedure outlined under "Main Bearings." If bearing clearances are satisfactory, apply engine oil to journals and bearings.
5. Install main bearing caps. Torque bolts to 80 lb. ft. (109 N·m). When tightening rear main bearing cap, follow procedure outlined under "Main Bearings."
6. Check crankshaft end play as outlined.
7. Install rear main seal retainer and seal. Torque fasteners to 135 lb. in. (15 N·m).
8. Check clearance for each connecting rod bearing, following procedure under "Connecting Rod Bearings." If bearing clearances are satisfactory, apply engine oil to journals and bearings.
9. Install rod caps and torque nuts to 45 lb. ft. (61 N·m).
10. Turn crankshaft so mark on timing sprocket or gear is facing camshaft.
11. Install as outlined:
    a. timing chain and sprocket or gear on camshaft - align marks with crankshaft
    b. timing chain/gear cover
    c. oil pump and baffle
    d. dipstick tube and oil pan
    e. spark plugs
    f. harmonic balancer and crankshaft pulley
    g. water pump
    h. belts
    i. flywheel and drive coupler/plate
    j. flywheel housing
    k. starter
12. Install new oil filter. Fill crankcase with oil.

Timing Chain and Sprocket Timing Gears

Left-hand (standard) and right-hand (opposite) rotation engines.

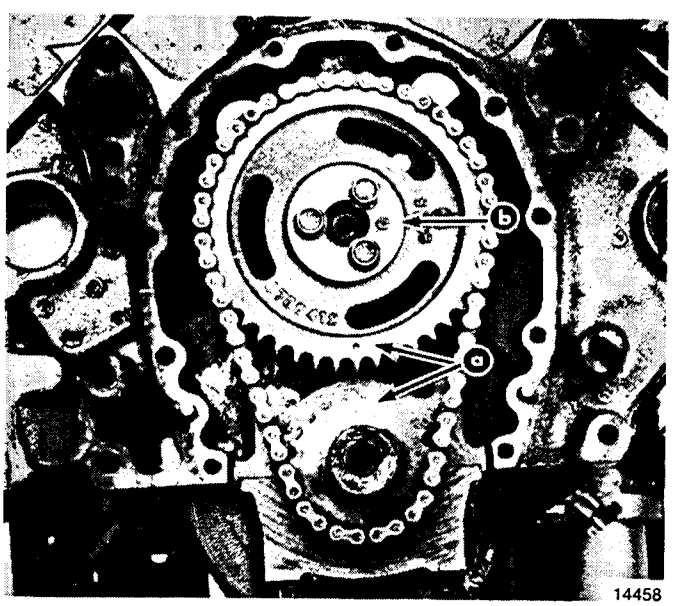
Removal

1. Remove harmonic balancer and crankcase front cover as outlined.
2. Turn crankshaft until timing marks on crankshaft and camshaft sprocket/gear are in alignment as shown.



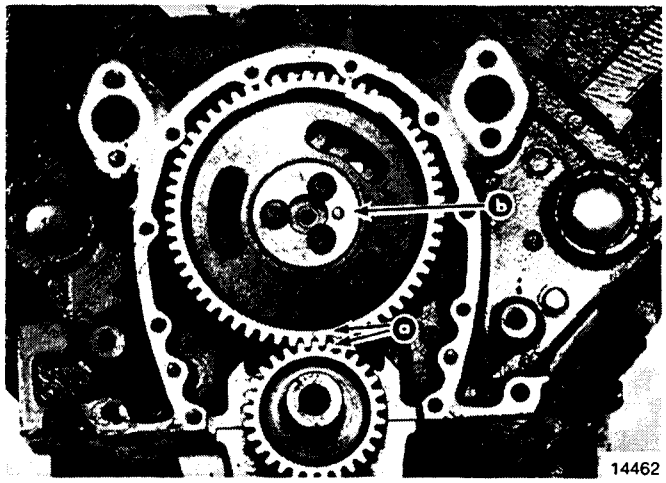
a - Timing Marks Aligned
b - Locating Pin

Aluminum/Nylon Camshaft Sprocket



a - Timing Marks Aligned
b - Locating Pin

All Metal Camshaft Sprocket



a - Timing Marks Aligned
b - Locating Pin

3. Remove camshaft gear or sprocket and timing chain. (If gear or sprocket does not come off easily, a light tap on the lower edge of the gear or sprocket, using a plastic mallet, should dislodge it.)
4. If crankshaft sprocket or gear requires replacement, remove as outlined.

Cleaning and Inspeciton

1. Clean all parts in solvent and dry with compressed air.
2. Inspect timing chain for wear or damage.
3. Inspect sprockets for wear or damage.
4. Inspect timing gears for worn or damaged teeth.
5. Inspect camshaft gear to cylinder block contact surfaces for damage.

Replacement Part Information

Some engines were originally equipped with link type timing chain and timing sprockets that have nylon teeth. If any of these components require replacement, a new timing chain assembly must be used. The timing chain assembly consists of a new roller type timing chain, an all-metal camshaft timing sprocket and a new crankshaft timing sprocket. The original components cannot be used in any combination with these replacement components.

Installation - Timing Gears

1. If removed, install crankshaft timing gear as outlined in "Crankshaft Sprocket/Gear."
2. Position camshaft timing gear so that timing mark aligns with timing mark on crankshaft timing gear, then align camshaft dowel with hole in camshaft gear and install gear on camshaft.

IMPORTANT: Do not attempt to drive gear on camshaft, as welsh plug at rear of engine can be dislodged.

3. Install bolts. Torque to 18 lb. ft. (24 N·m).
4. Check timing gear backlash and runout as explained under "Checking Backlash and Runout."
5. Lubricate timing gears with engine oil.
6. Install crankcase front cover, oil pan and harmonic balancer as explained.

Installation - Timing Chain

1. If crankshaft sprocket was removed, install as outlined in "Crankshaft Sprocket/Gear."
2. Install timing chain on camshaft sprocket. Hold sprocket vertical with chain hanging down. Align marks on camshaft and crankshaft sprockets.

IMPORTANT: Do not attempt to drive sprocket on camshaft, as welsh plug at rear of engine can be dislodged.

3. Install sprocket on camshaft. Torque bolts to 18 lb. ft. (24 N·m).
4. Lubricate timing chain with engine oil. Install crankcase front cover and harmonic balancer as outlined.

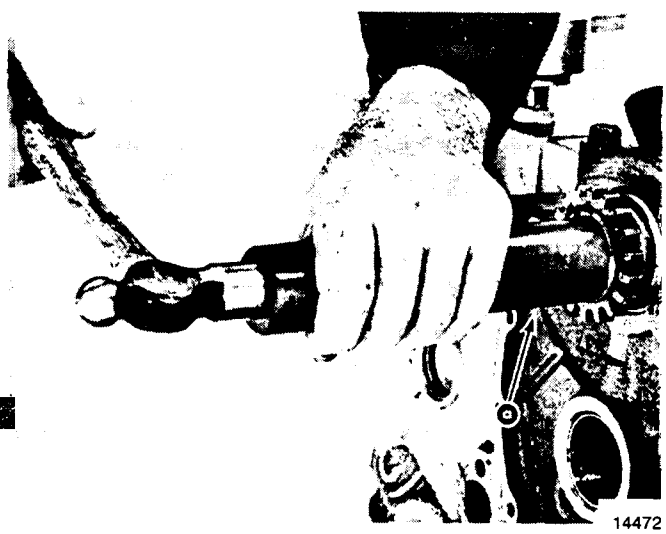
Crankshaft Sprocket/Gear

Removal

1. Remove harmonic balancer and crankcase front cover as outlined.
2. Remove camshaft timing chain/gear as outlined.
3. a. On left-hand rotation engines, remove crankshaft sprocket using tool J-5825-A.
   b. On right-hand rotation engines, remove crankshaft gear using a universal puller.

Installation

1. Using tool J-5590, as shown, install sprocket or gear on crankshaft.



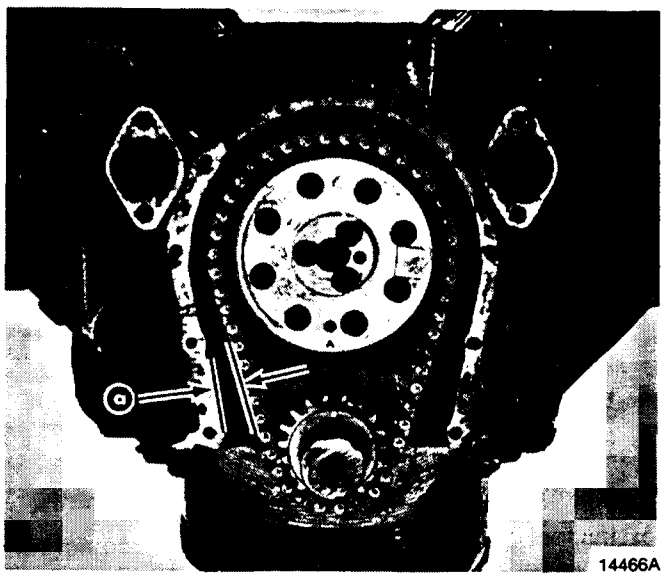
a - Tool J-5590

2. Install timing chain or gear as outlined.
3. Install crankcase cover and harmonic balancer as outlined.

Checking Timing Chain Deflection

With timing chain and sprockets installed, check timing chain deflection, as follows:

1. Rotate camshaft (in either direction) to place tension on one side of the chain.
2. Establish a reference point on the block (on taut side of chain) and measure from this point to the chain.
3. Rotate camshaft in the opposite direction to slacken the chain, then force chain out with fingers and again measure the distance between reference point and timing chain.
4. The deflection is the difference between these two measurements. If the deflection exceeds 3/4 in. (19mm), timing chain should be replaced.

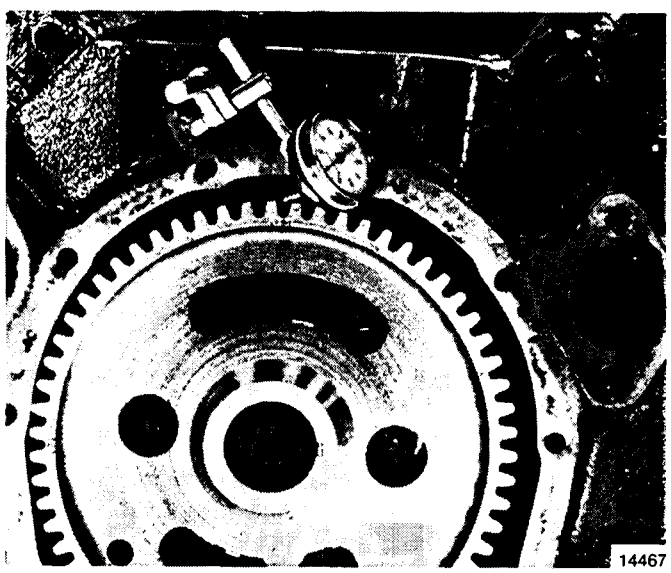


a - Reference Point

Checking Timing Chain Deflection

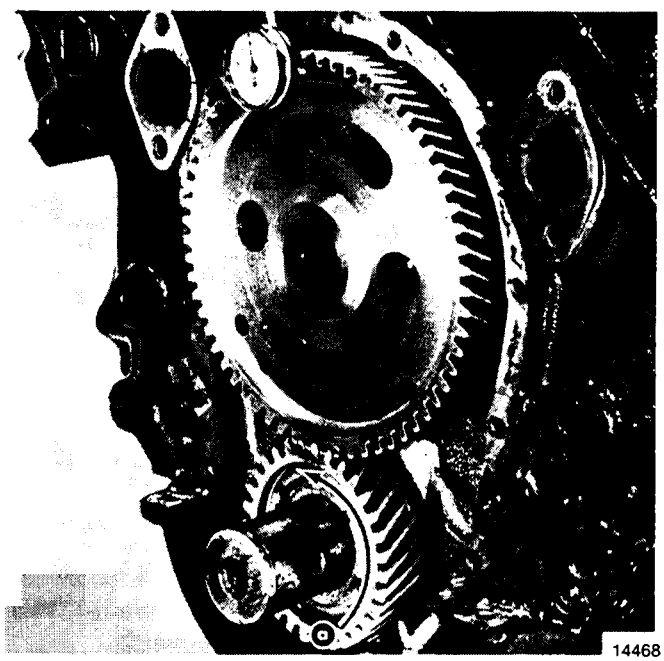
Checking Timing Gear Backlash and Runout

1. Remove fuel pump and fuel pump push rod.
2. Loosen rocker arm nuts (to relieve tension on hydraulic valve lifters).
3. With timing gears installed, check camshaft to crankshaft gear backlash, as follows:
   a. Mount a dial indicator on engine so that indicator stem contacts one of the teeth on camshaft gear. Indicator stem should be as perpendicular to gear tooth surface as possible.
   b. Check the backlash between the camshaft gear and crankshaft gear while applying inward pressure on camshaft gear.
   c. If backlash is not within .004-.006 in. (.102-.152mm) for new gears or .004-.008 in. (.102-.203mm) for used gears, check for improperly machined parts or worn camshaft or crankshaft bearings. If bearings check out good, replace both timing gears.



Checking Backlash (7.4 Litre Engine Shown)

4. With timing gear installed, check camshaft and crankshaft timing gear runout, as follows:
   a. Mount dial indicator on block so that indicator stem is perpendicular to camshaft timing gear and contacts gear surface just adjacent to teeth.
   b. Apply inward pressure on timing gear and zero indicator, then turn crankshaft as shown. Check gear runout through one complete revolution of camshaft gear.
   c. If not within .004 in. (.102mm), check for burrs or foreign material between gear and camshaft joining surfaces. If none is found, replace both timing gears.
   d. Check crankshaft timing gear runout in same manner. Runout should not exceed .003 in. (.076 mm). Replace both gears, if runout is excessive.
5. Adjust rocker arm nuts.
6. Install fuel pump push rod and fuel pump.



a - Turn Crankshaft In This Direction

Checking Gear Runout (7.4 Litre Engine Shown)

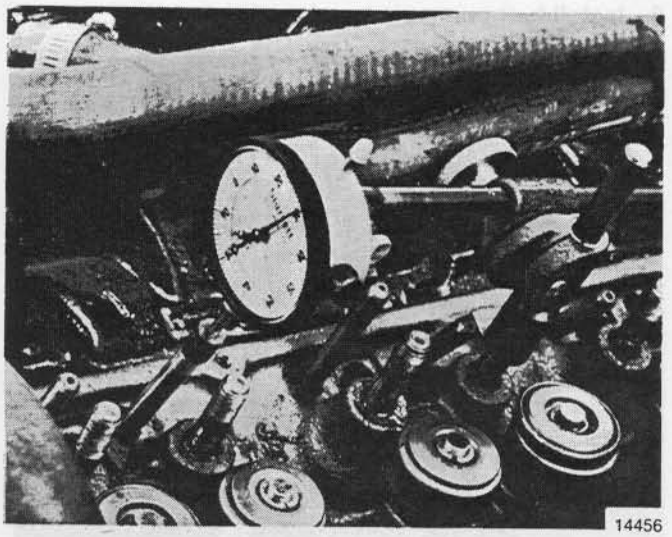
Camshaft

Measuring Lobe Lift

NOTE: Procedure is similar to checking valve timing. If improper valve operation is indicated, measure lift of each push rod in consecutive order and record readings.

IMPORTANT: Engines with Engine Block Code Letters "CD" have roller lifters and special steel camshaft with different lobe lift measurements than engines with flat lifters. Refer to Engine Identification and Engine Specifications to verify measurements.

1. Remove valve mechanism as outlined.
2. Position indicator with ball socket adapter Tool J-8520 on push rod. Be sure that push rod is in lifter socket.

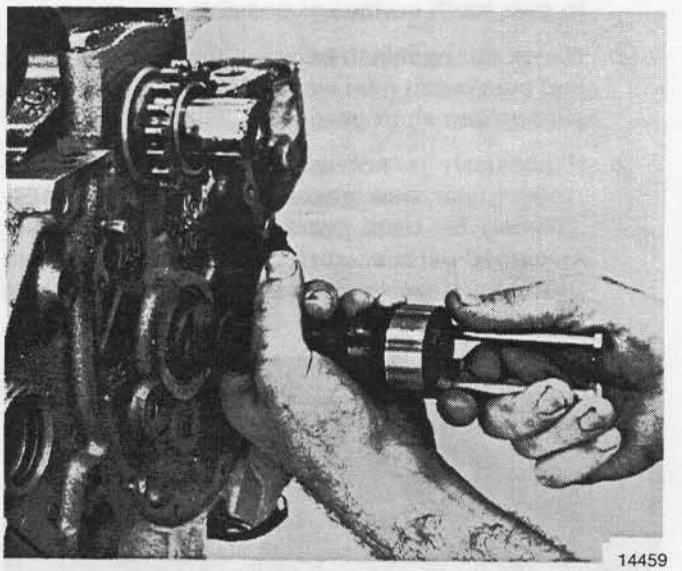


Measuring Camshaft Lobe Lift

3. Rotate crankshaft damper slowly in direction of rotation until lifter is on heel of cam lobe. At this point, push rod will be in its lowest position.
4. Set dial indicator on zero, then rotate balancer slowly (or attach an auxiliary starter switch and "bump" engine over) until push rod is in fully raised position.
5. Compare total lift, recorded from dial indicator, with "Specifications."
6. Continue to rotate engine until indicator reads zero. This will be a check on accuracy of original indicator reading.
7. If camshaft readings for all lobes are within specifications, remove dial indicator assembly.
8. Install and adjust valve mechanism as outlined.

Removal

1. Remove valve lifters as outlined.
2. Remove crankcase front cover as outlined.
3. Remove fuel pump and fuel pump push rod.
4. Remove camshaft as follows:
   a. Remove timing chain and sprocket or timing gears as outlined.
   b. Install two 5/16-18 x 5 in. bolts in camshaft bolt holes and carefully remove camshaft as shown.



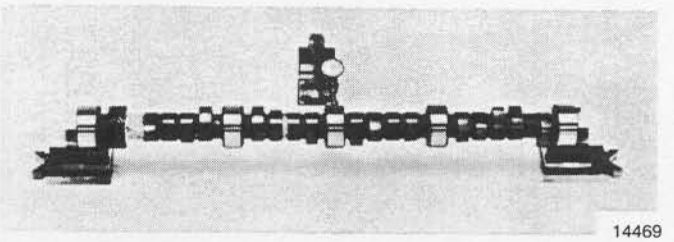
Removing Camshaft

Inspection

Measure camshaft bearing journals with a micrometer for out-of-round condition. If journals exceed .001 in. (.025mm) out-of-round, camshaft should be replaced.

Also check camshaft for alignment with "V" blocks and dial indicator which indicates exact amount camshaft is out-of-true. If out more than .002 in. (.051mm) (dial indicator reading) camshaft should be replaced.

On engines with timing gears, inspect camshaft gear and thrust plate for wear or damage.



Checking Camshaft Alignment

Installation

1. Install camshaft as follows:
   a. Install two 5/16-18 x 5 in. bolts in camshaft bolt holes, then lubricate camshaft journals with engine oil and install camshaft, being careful not to damage bearings.
   b. Lubricate camshaft lobes with General Motors Engine Oil Supplement or equivalent.
   c. Install timing chain or gears as outlined.
2. Install fuel pump push rod and fuel pump.
3. Install crankcase front cover and valve lifters as outlined.

Camshaft Bearings

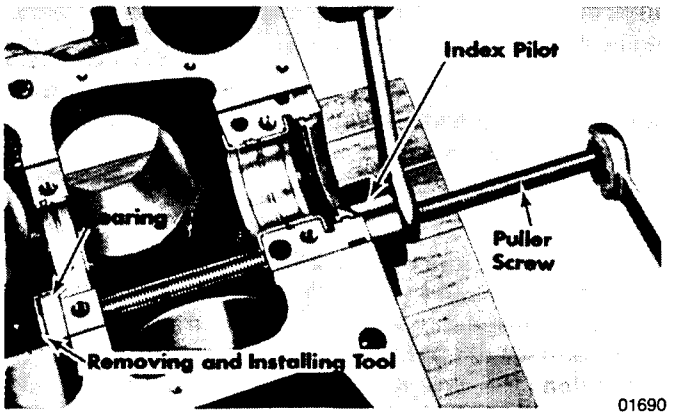
Removal

Camshaft bearings can be replaced while engine is disassembled for overhaul or without complete disassembly. To replace bearings without complete disassembly, remove camshaft and crankshaft, leaving cylinder heads attached and pistons in place. Before removing crankshaft. Fasten connecting rod against sides of engine so that they will not interfere while replacing camshaft bearings.

1. With camshaft and crankshaft removed, drive camshaft rear plug from cylinder block.

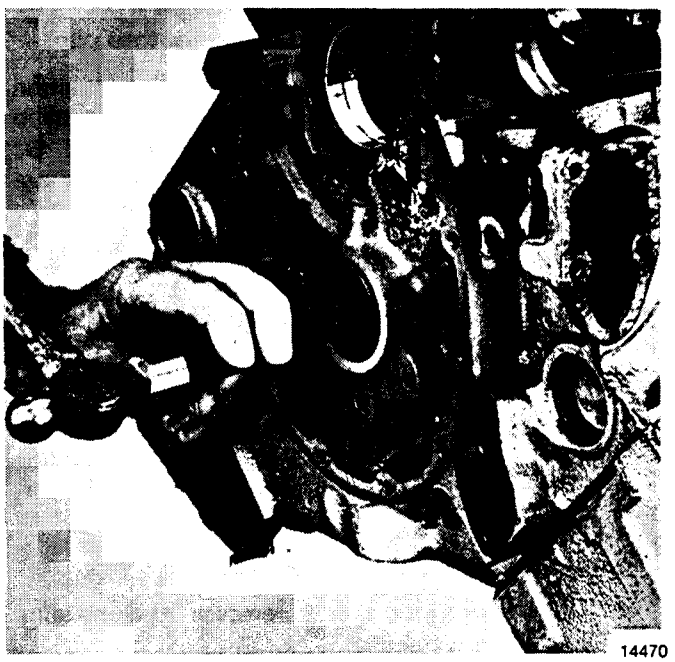
NOTE: This procedure is based on removal of bearings center of engine first, thus requiring a minimum amount of turns to remove all bearings.

2. Using tool set J-6098-01 (with nut and thrust washer installed to end of threads), position pilot in front camshaft bearing and install puller screw through pilot.
3. Install tool with shoulder toward bearing. Be sure a sufficient amount of threads are engaged.
4. Using 2 wrenches, hold puller screw while turning nut. When bearing has been pulled from bore, remove tool and bearing from puller screw.
5. Remove remaining bearings (except front and rear) in same manner. It will be necessary to position pilot in rear camshaft bearing to remove rear intermediate bearing.



Replacing Camshaft Bearings

6. Assemble remover tool on driver handle and remove front and rear camshaft bearings by driving toward center of cylinder block.



Replacing Front and Rear Camshaft Bearings

Inspection

Clean camshaft bearing bores in cylinder block with solvent and blow out with compressed air. Be sure grooves and drilled oil passages are clean.

Installation

Front and rear bearings must be installed last as pilot will not fit into bearing bores if bearings are installed.

Lubricate outer surface of new camshaft bearings with engine oil to ease installation.

IMPORTANT: All camshaft bearings are not the same. Be sure to install bearing in proper location (indicated by bearing manufacturer) and to position bearings as follows: (Directional references are in reference to engine in its normal operating position.)

- **Front bearing must be positioned so that oil holes are equal distance from 6 o'clock position in the block. Intermediate and center bearings must be positioned so that oil holes are at the 5 o'clock position (toward left side of block and at a position even with bottom of cylinder bore). Rear bearing must be positioned so that oil hole is at the 12 o'clock position.**

1. **Installing Intermediate and Center Bearings:**
   a. Install nut and thrust washer all-the-way onto puller screw, then position pilot in front camshaft bearing bore and insert screw thru pilot.
   b. Index center camshaft bearing, then position appropriate size remover and installer tool in bearing and thread puller screw into tool. Be sure at least 1/2 in. (13mm) of threads are engaged.
   c. Using 2 wrenches, hold puller screw and turn nut until bearing has been pulled into position. Remove the remover and installer tool and check to ensure that oil hole(s) in bearing are positioned correctly.
   d. Install intermediate bearings in same manner being sure to index bearings correctly. It will be necessary to position pilot in rear camshaft bearing bore to install rear intermediate bearing.
2. **Installing Front and Rear Bearings:**
   a. Install appropriate size remover and installer tool on drive handle.
   b. Index front bearing (as explained in "Important"), and drive it into position with tool. Check position of oil hole(s) in bearing to ensure bearing is positioned correctly.
   c. Install rear bearing in same manner, being sure to index bearing correctly.
3. Install a new camshaft rear plug.

IMPORTANT: Plug must be installed flush to 1/32 in. (.8mm) deep and must be parallel with rear surface of cylinder block.

4. Install crankshaft and camshaft as outlined.

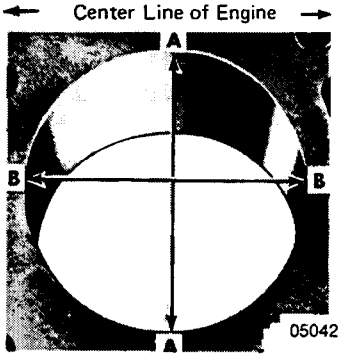
Cylinder Block

Cleaning and Inspection

1. Remove all engine components as previously outlined.
2. Wash cylinder block thoroughly in cleaning solvent and clean all gasket surfaces.
3. Remove oil gallery plugs and clean all oil passages.
4. Remove expansion plugs.

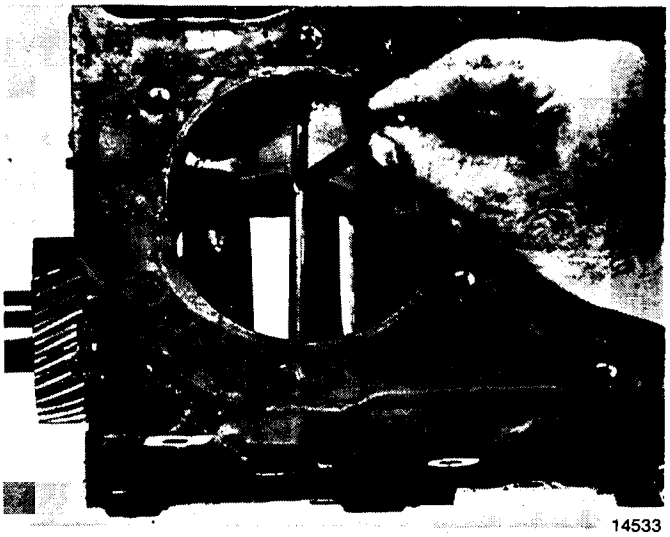
NOTE: These plugs may be removed with a sharp punch, or they may be drilled and pried out.

5. Clean and inspect water passages in cylinder block.
6. Inspect cylinder block for cracks in cylinder walls, water jacket valve lifter bores and main bearing webs.
7. Measure cylinder walls for taper, out-of-round or excessive ridge at top of ring travel. This should be done with a dial indicator or inside micrometer. Carefully work gauge up and down cylinder to determine taper and turn it to different points around cylinder wall to determine out-of-round condition. If cylinders exceed specifications, boring and/or honing will be necessary.

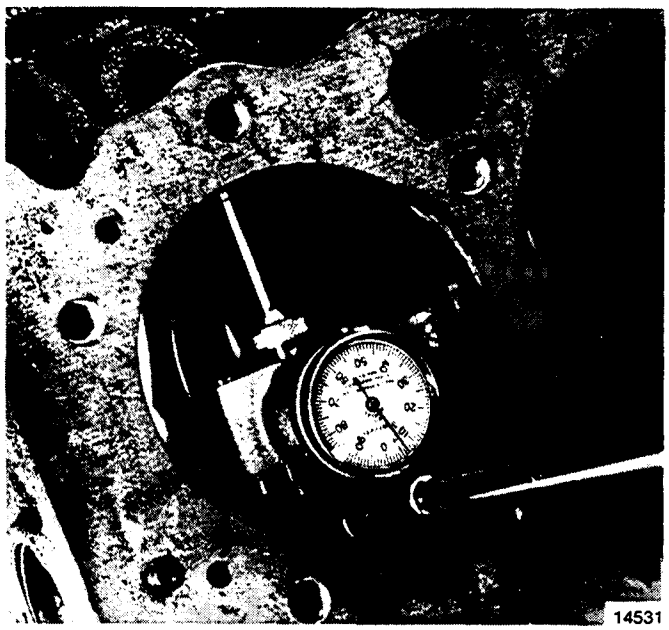


"A" = At right angle to centerline of engine
"B" < Parallel to centerline of engine
"Out-of-round" = Difference between "A" and "B"
"Taper" = Difference between measurement "A" at top of cylinder bore and "A" measurement at bottom of cylinder bore.

Cylinder Measurement

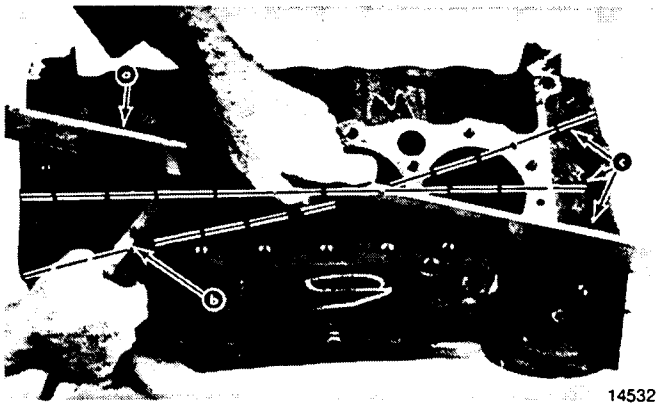


Measuring Cylinder Bore



Measuring Cylinder Bore

8. Check cylinder head gasket surfaces for warpage with a machinists straight edge and a feeler gauge, as shown. Take measurements diagonally across surfaces (both ways) and straight down center. If surfaces are out-of-flat more than .003 in. (.07mm) in a 6 in. area or .007 in. (.2mm) overall, block must be resurfaced by an automotive machine shop.



a - Machinists Straight Edge
b - Feeler Gauge
c - Take Measurements Diagonally Across Surface and Straight Down Center

Checking Cylinder Head Gasket Surfaces for Warpage

CYLINDER CONDITIONING

1. Performance of the following operation depends upon engine condition at time of repair.
2. If cylinder block inspection indicates that block is suitable for continued use (except for out-of-round or tapered cylinders), they can be conditioned by honing or boring.
3. If cylinders have less than .005 in. (.127mm) taper or wear, they can be conditioned with a hone and fitted with high limit standard size piston. A cylinder bore of less than .005 in. wear or taper may not clean up entirely when fitted to a high limit piston. To entirely clean up the bore, it will be necessary to rebore for an oversize piston. If more than .005 in. taper or wear, bore and hone to smallest oversize that will permit complete resurfacing of all cylinders.
4. When pistons are being fitted and honing is not necessary, cylinder bores may be cleaned with a hot water and detergent wash. After cleaning, swab cylinder bores several times with light engine oil and a clean cloth, then wipe with a clean dry cloth.

CYLINDER BORING

1. Before using any type boring bar, file off top of cylinder block to remove dirt or burrs. This is very important to prevent boring bar tilt, with result that rebored cylinder wall is not at right angles to crankshaft.
2. Measure piston to be fitted with a micrometer, measuring at center of piston skirt and at right angles to piston pin. Bore cylinder to same diameter as piston and hone to give specified clearance.

NOTE: Hone cylinders as outlined under "Cylinder Honing" and "Piston Selection," following.

3. Carefully observe instructions furnished by manufacturer of equipment being used.

CYLINDER HONING

1. Follow hone manufacturer's recommendations for use of hone and cleaning and lubrication during honing.
2. Occasionally, during the honing operation, thoroughly clean cylinder bore and check piston for correct fit in cylinder.
3. When finish-honing a cylinder bore to fit a piston, move hone up-and-down at a sufficient speed to obtain very fine uniform surface finish marks in a cross-hatch pattern of approximately 30° to cylinder bore. Finish marks should be clean but not sharp, free from imbedded particles and torn or folded metal.
4. Permanently mark piston (for cylinder to which it has been fitted) and proceed to hone cylinders and fit remaining pistons.

IMPORTANT: Handle pistons with care and do not attempt to force them through cylinder until cylinder is honed to correct size, as this type piston can be distorted by careless handling.

5. Thoroughly clean cylinder bores with hot water and detergent. Scrub well with a stiff bristle brush and rinse thoroughly with hot water. It is extremely essential that a good cleaning operation be performed. If any abrasive material remains in cylinder bores, it will rapidly wear new rings and cylinder bores in addition to bearings lubricated by the contaminated oil. Swab bores several times with light engine oil on a clean cloth, then wipe with a clean dry cloth. Cylinder should not be cleaned with kerosene or gasoline. Clean remainder of cylinder block to remove excess material spread during honing operation.

PISTON SELECTION

1. Check used piston to cylinder bore clearance as follows:
   a. Measure "cylinder bore diameter" with a telescope gauge 2-1/2 in. (64mm) from top of cylinder bore as shown.

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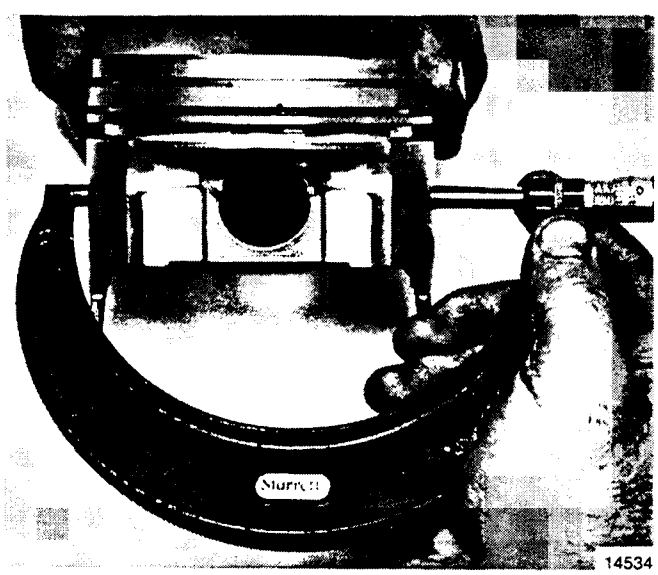
Measuring Cylinder Bore

   b. Measure "piston diameter" at skirt across center line of piston pin as shown.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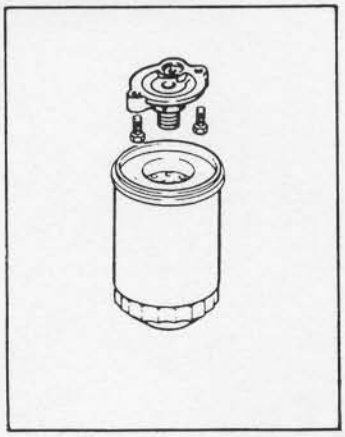
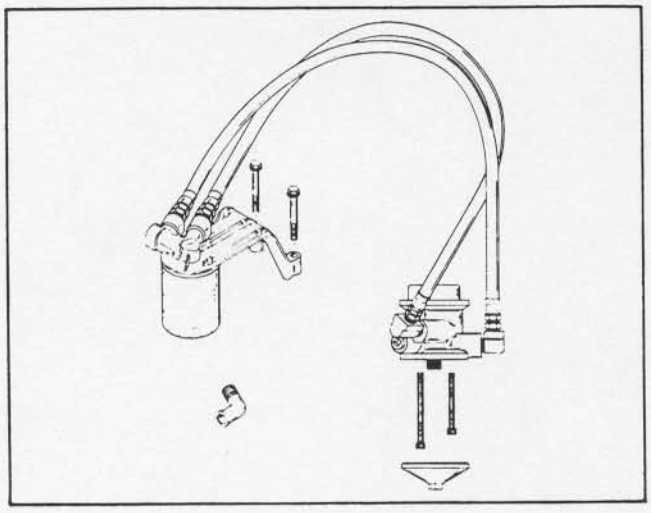
Measuring Piston

   c. Subtract piston diameter from cylinder bore diameter to determine "piston-to-bore clearance."
   d. Determine if "piston-to-bore clearance" is in acceptable range shown in "Specifications".

2. If used piston is not satisfactory, determine if a new piston can be selected to fit cylinder bore within acceptable range.
3. If cylinder bore must be reconditioned, measure new piston diameter (across centerline of piston pin), then hone cylinder bore to correct clearance (preferable range).
4. Mark piston to identify cylinder for which it was fitted.

Oil Filter By-Pass Valve and Adaptor Assembly



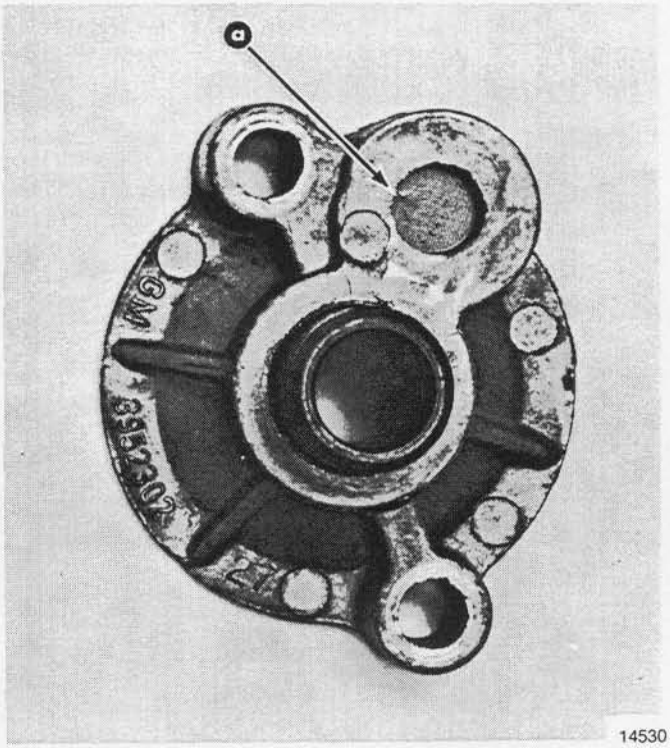


Inspection and/or Replacement

Oil by-pass valve and adaptor assembly should be inspected whenever engine is disassembled for major repair or whenever inadequate oil filteration is suspected.

Refer to "Engine Parts List" when ordering parts for oil filter by-pass valve, adaptor assembly or remote oil filter parts.

1. Remove oil filter (on engines with block mounted filter) or cylinder block adaptor (on engines with remote oil filter) and remove by-pass valve and adaptor assembly.
2. Clean by-pass valve and adaptor assembly in solvent and blow dry with compressed air.
3. Inspect fiber valve for cracks or other damage. Check that valve fits tightly against its seat. Push valve down and release it. Valve should return freely to its seat. If valve operation is questionable, by-pass valve and adaptor assembly should be replaced.



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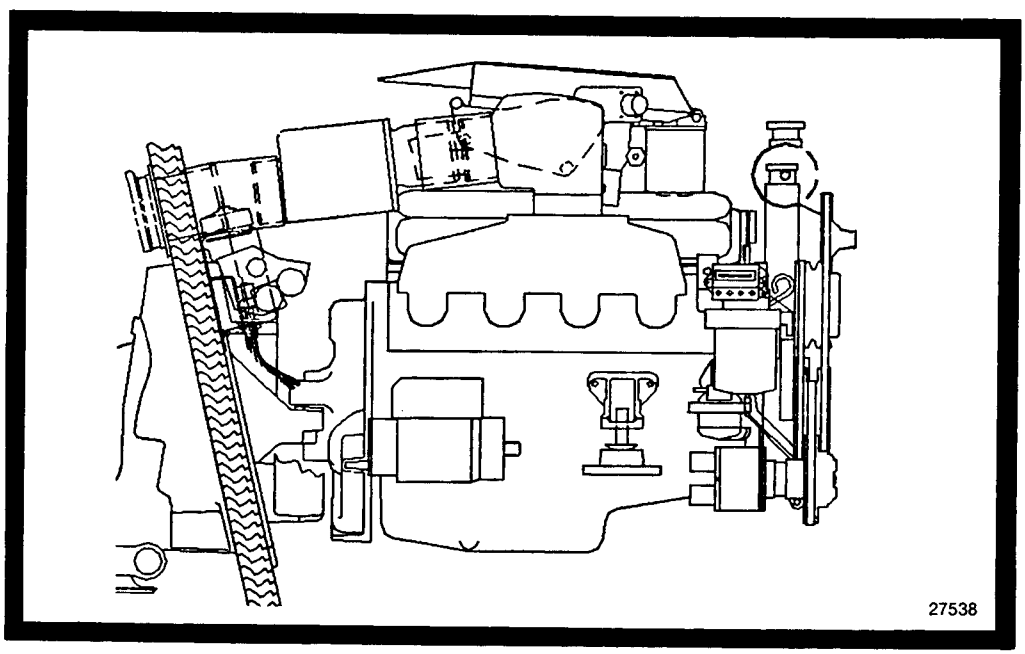
a - Fiber Valve (Be Sure Valve Fits Tightly Against its Seat)

Typical By-Pass Valve and Adaptor Assembly

4. Wipe out valve chamber in cylinder block to remove any foreign material.
5. Install by-pass valve and adaptor assembly or cylinder block adaptor to engine block. Tighten bolts to 80 lb. in. (9 N·m).
6. Lubricate oil filter rubber seal and install hand-tight only.

ENGINE

3
B



V-8 454/502 CID
(7.4/8.2 LITRE)

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Torque Specifications (see NOTE)

Fastener Location	454/502 (7.4/8.2 Litre) CID	
	Lb. Ft. (N·m)	Lb. In. (N·m)
Alternator Brace to Alternator	16 (28)	192 (28)
Alternator Brace to Block	30 (41)	
Alternator to Mounting Bracket	35 (48)	
Alternator Mounting Bracket	30 (41)	
Camshaft Sprocket	20 (26)	
Camshaft Thrust Plate Screws (R.H. Only)		96 (111)
Carburetor		132 (15)
Connecting Rod Cap	50 (68)	
Coupler/Flywheel (MCM)	35 (48)	
Crankshaft (Torsional) Damper	85 (115)	
Crankshaft Pulley	35 (48)	
Cylinder Head	80 (109)	
Distributor Hold Down	25 (34)	
Exhaust Manifold	20 (27)	
Flywheel	65 (88)	
Flywheel Drive Plate (MIE)	35 (48)	
Flywheel Housing to Block	30 (41)	
Flywheel Housing Cover		80 (9)
Front Mount Bracket	30 (41)	
Fuel Pump	25 (34)	
Intake Manifold	30 (41)	
Main Bearing Cap	110 (149)	
Oil Pan Plug	20 (27)	
Oil Pan Screw (1/4"-20)		70 (8)
Oil Pan Screw (5/16"-18)		160 (18)
Oil Pump	65 (88)	
Oil Pump Cover		80 (9)
Power Steering Pump Brace to Block	30 (41)	
Power Steering Pump Bracket	30 (41)	
Rear Mount Bolts (MCM)	40 (54)	
Rear Mounts (MIE)	50 (68)	
Remote Oil Filter Adaptor (5/16"-18)	20 (27)	
Remote Oil Filter Adaptor Cover	15 (20)	180 (20)
Rocker Arm Cover		115 (13)
Rocker Arm Studs	50 (68)	

NOTE: See following page for "Special Torque Specifications for Generation V Engines."

Fastener Location	454/502 (7.4/8.2 Litre) CID	
	Lb. Ft. (N·m)	Lb. In. (N·m)
Seawater Pump Brace	30 (41)	
Seawater Pump Bracket	30 (41)	
Spark Plugs	15 (20)	180 (20)
Starter Motor	50 (68)	
Thermostat Housing	30 (41)	
Timing Chain or Gear Cover		80 (9)
Transmission to Housing	50 (68)	
Water Circulating Pump	30 (41)	
Water Temp. Sender	20 (27)	
Oil Baffle Nuts	25 (34)	

Special Torque Specifications for Generation V Engines (see NOTE)

Fastener Location	Gen. V 454/7.4L
Camshaft Sprocket	25 lb. ft. (34 N·m)
Conn. Rod Cap	73 lb. ft. (99 N·m)
Coupler or Drive Plate	35 lb. ft. (48 N·m)
Cylinder Head	85 lb. ft. (115 N·m)
Distributor Clamp	20 lb. ft. (27 N·m)
Exhaust Manifold (Bolts)	30 lb. ft. (41 N·m)
Flywheel	70 lb. ft. (95 N·m)
Flywheel Housing	30 lb. ft. (41 N·m)
Front Cover	120 lb. in. (14 N·m)
Intake Manifold	35 lb. ft. (48 N·m)
Main Bearing Cap	110 lb. ft. (149 N·m)
Oil Filter Adaptor Nut	40 lb. ft. (54 N·m)
Oil Pan to Crankcase	200 lb. in. (23 N·m)
Oil Pan Drain Plug	15 lb. ft. (20 N·m)
Oil Pump	70 lb. ft. (95 N·m)
Oil Pump Cover	80 lb. in. (9 N·m)
Rocker Arm Bolts	45 lb. ft. (61 N·m)
Rocker Arm Cover	70 lb. in. (8 N·m)
Spark Plug	22 lb. ft. (30 N·m)
Crankshaft (Torsional) Damper	90 lb. ft. (122 N·m)
Water Circulating Pump	35 lb. ft. (48 N·m)

NOTE: Refer to "Torque Specifications" for items not shown in above Generation V chart.

Tools/Lubricants/Sealants

MERCURY MARINE SPECIAL TOOLS	
91-24697	Piston Ring Expanders
91-35547	Engine Coupler Wrench
91-66273	Rocker Stoppers

KENT-MOORE SPECIAL TOOLS Kent-Moore Tools, Inc. 29784 Little Mack Roseville, MI 48066 Phone: (313) 574-2332	
J5892-C	Valve Spring Compressor
J8062	Valve Spring Compressor
J8056	Valve Spring Tester
J8101	Valve Guide Cleaner
J5830-2	Valve Guide Reamer
J7049	Valve Guide Reamer Set
J5590	Crankshaft Gear Installer
J23590	Air Adaptor
J35228	Connecting Rod Bolt Guide Set (7/16 in. Bolts)
J8089	Carbon Remover Brush
J24086-100	Piston Pin Tool
J3936-03	Piston Ring Groove Cleaner
J8037	Piston Ring Compressor
J5239	Connecting Rod Bolt Guide Set (3/8 in. Bolts)
J6098-01	Camshaft Bearing Remover and Installer Tool
J23523-E	Harmonic Balancer Removal and Installer Tool
J22102	Crankcase Front Cover Seal Installer
J21058-20	Crankshaft Gear Installer
J5825-A J24420-B	Crankshaft Gear Puller
J-8520	Cam Lobe Lift Indicator
	Rear Main Oil Seal Installer

LUBRICANTS/SEALANTS	
92-32609-1	Quicksilver Loctite
92-34227	Quicksilver Perfect Seal
92-42649A1	Quicksilver Needle Bearing Assembly Lubricant
92-91601-1	Quicksilver RTV Sealer
92-86166	Quicksilver Bellows Adhesive

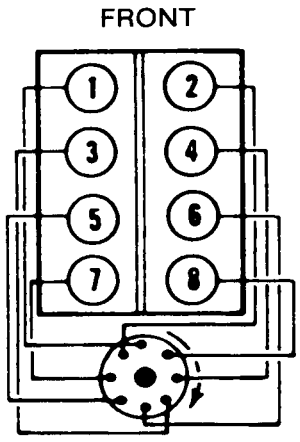
LUBRICANT OBTAINED LOCALLY
General Motors Engine Oil Supplement or its equivalent

Engine Specifications - Mark IV Engines (see Note)

UNIT OF MEASUREMENT in. (mm)

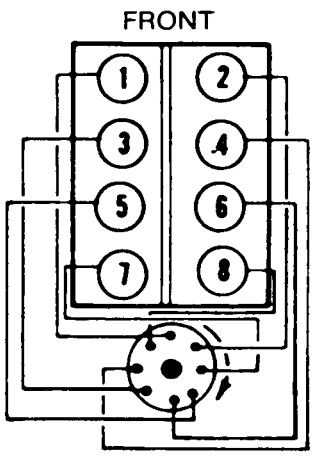
ENGINE MODEL	MCM 7.4 LITRE	MIE 7.4 LITRE	454 MAGNUM	502 MAGNUM	MIE 8.2 LITRE
Displacement	454 CID (7.4 Litre)			502 CID (8.2 Litre)	
Bore	4.25 (107.95)			4.46 (113.28)	
Stroke	4.00 (101.6)				
Compression Ratio	8.5:1		8.8:1	8.75:1	
Heads	Cast Iron (Oval Port)		Cast Iron (Rectangle Port)		
Intake Manifold	Cast Iron		Aluminum Hi-Rise		
Block *	Cast Iron (4 Bolt Main Bearing Caps)				
Rods	Forged Steel				
Pistons	Cast Aluminum		Forged Aluminum		
Crankshaft	Cast Iron		Forged Steel		
Rocker Arms	Stamped Steel				

*** Some 1988 Blocks May Have 2 Bolt Main Bearing Caps.**



Firing Order
1-8-4-3-6-5-7-2

Left-Hand (Standard) Rotation Engine



Firing Order
1-2-7-5-6-3-4-8

Right-Hand (Opposite) Rotation Engine

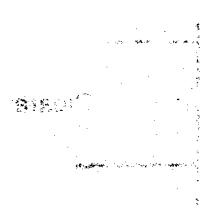
NOTE: See "Engine Specifications - Generation V Engines" for Generation V Model Engines.

Engine Specifications - Mark IV Engines (continued)

ENGINE				7.4 LITRE	454 MAGNUM	8.2 LITRE 502 MAGNUM
Cylinder Bore:						
Diameter				4.2451 - 4.2525 (107.8255 - 108.0135)		4.4650 - 4.4725 (113.411 - 113.601)
Out of Round	Production			.001 (0.025)		
	Service			.002 (0.05)		
Taper	Production	Thrust Side		.005 (0.127) Max.		
		Relief Side		.001 (0.025) Max.		
	Service			+ .001 (0.025) Over Production		
Piston:						
Clearance	Production			.0014 - .0024 (0.0356 - 0.0610)	.0045 - .0065 (0.1143 - 0.1651)	.0040 - .0057 (0.1016 - 0.1447)
	Service			.0035 (0.09) Max.	.0075 (0.15) Max.	.0065 (0.16) Max.
Piston Ring:						
Compression	Groove Side Clearance	Production	Top	.0017 - .0032 (0.04 - 0.08)		.0017 - .0032 (0.0432 - 0.0812)
			2nd	.0017 - .0032 (0.04 - 0.08)		.0017 - .0032 (0.0432 - 0.0812)
		Service		.005 (0.127) Max.		+ .001 (0.02) Max.
	Gap	Production	Top	.010 - .020 (0.25 - 0.5)		.010 - .020 (0.254 - 0.508)
			2nd	.010 - .020 (0.25 - 0.5)		.010 - .020 (0.254 - 0.508)
		Service		.018 - .022 (0.4572 - 0.5588)		+ .010 (0.25)
Oil	Groove Side Clearance	Production		.005 - .0065 (0.13 - 0.15)		.005 - .0065 (0.127 - 0.165)
		Service		.005 - .008 (0.13 - 0.2032)		.001 (0.02) Max.
	Gap	Production		.015 - .055 (0.35 - 1.35)	.020 - .035 (0.5 - 0.85)	.020 - .035 (.508 - 0.889)
		Service		.015 - .055 (0.381 - 1.397)		.010 (0.25)
Piston Pin:						
Diameter				.9895 - .9898 (25.1333 - 25.1409)		.98945 - .9898 (25.13203 - 25.1409)
Clearance	Production			.00025 - .00035 (0.00635 - 0.00889)		.00025 - .00035 (0.00635 - 0.00889)
	Service			.001 (0.02) Max.		
Fit in Rod				.0008 - .0016 (0.0203 - 0.0406) Interference		

Engine Specifications - Mark IV Engines (continued)

ENGINE			7.4 LITRE — 454 MAGNUM	8.2 LITRE — 502 MAGNUM
Crankshaft:				
Main Journal	Diameter	No. 1	2.7481 - 2.7490 (69.80174 - 69.8246)	2.7485 - 2.7494 (69.8119 - 69.8348)
		No. 2, 3, 4	2.7481 - 2.7490 (69.8017 - 69.8246)	
		No. 5	2.7478 - 2.7488 (69.7941 - 69.8195)	
	Taper	Production	.0002 (0.0051) Max.	
		Service	.001 (0.025) Max.	
	Out of Round	Production	.0002 (0.0051) Max.	
		Service	.001 (0.025) Max.	
Main Bearing Clearance	Production	No. 1 No. 2, 3, 4	.0013 - .0025 (0.0330 - 0.0635)	
		No. 5	.0024 - .0040 (0.0610 - 0.1016)	
	Service	No. 1	.001 - .0015 (0.03)	.001 - .0015 (0.025 - 0.038)
		No. 2, 3, 4	.001 - .0025 (0.03 - 0.06)	
		No. 5	.0025 - .004 (0.06 - 0.1016)	.0025 - .0035 (0.07 - 0.08)
Crankshaft End Play			.006 - .010 (0.15 - 0.25)	
Connecting Rod Journal	Diameter		2.1990 - 2.200 (55.8546 - 55.88)	2.1985 - 2.1995 (55.8419 - 55.8673)
	Taper	Production	.0005 (0.0127) Max.	
		Service	.001 (0.025) Max.	
	Out of Round	Production	.0005 (0.0127) Max.	
		Service	.001 (0.025) Max.	
Rod Bearing Clearance		Production	.0009 - .0025 (0.0229 - 0.0635)	
		Service	.003 (0.07) Max.	.0030 (0.076)
Rod Side Clearance			.013 - .023 (0.35 - 0.55)	
Crankshaft Runout			.003 (0.0762) Max. [Check at #3 Main Bearing]	.0015 (0.0381) Max.



Engine Specifications - Mark IV Engines (continued)

ENGINE		7.4 LITRE	454 MAGNUM 8.2 LITRE — 502 MAGNUM
Camshaft and Drive:			
Lobe Lift ± .002 (0.051)	Intake	.271 (6.883)	.300 (7.62)
	Exhaust	.282 (7.163)	.300 (7.62)
Duration	Intake	.350° Note 1	.224° Note 2
	Exhaust	.352° Note 1	.224° Note 2
Journal Diameter		1.9477 - 1.9497 (49.47158 - 49.52238)	1.9482 - 1.9492 (49.4842 - 49.5096)
Journal Out-of-Round		.001 (0.025) Max.	
Camshaft Runout		.0015 (0.0381)	.002 (0.051 Max.)
Timing Chain Deflection [L.H. (Standard) Rotation Engines Only]		3/8 (10) From Taut Position [3/4 (19) Total]	
Camshaft End Play [R.H. (Opposite) Rotation Engines Only]		.001 - .005 (0.03 - 0.1)	Not Applicable
Camshaft Timing Gear Runout [R.H. (Opposite) Rotation Engines Only]		.004 (0.102) Max.	
Crankshaft Timing Gear Runout [R.H. (Opposite) Rotation Engines Only]		.003 (0.076) Max.	
Camshaft to Crankshaft Timing Gear Backlash [R.H. (Opposite) Rotation Engines Only]	New Gears	.004 - .006 (0.102 - 0.152)	
	Used Gears	.004 - .008 (0.102 - 0.203)	

NOTE 1: Duration given is "advertised duration."

NOTE 2: Duration @ .050 (1.27) cam lift.

ENGINE	7.4 LITRE — 454 MAGNUM	8.2 LITRE — 502 MAGNUM
Cylinder Head:		
Gasket Surface Flatness	.007 (0.178) Overall Max.	.003 (0.07) in 6 inch (152m) area
	.010 (0.254) Overall Max. for 1990 Engines	.007 (0.17) Overall Maximum
Flywheel:		
Runout	.008 (0.203) Max.	

Engine Specifications - Mark IV Engines (continued)

ENGINE			7.4 LITRE	454 MAGNUM	8.2 LITRE 502 MAGNUM
Valve System:					
Lifter Type			Hydraulic		
Rocker Arm Ratio			1.70:1		
Valve Lift	Intake		.461 (11.701)	.510 (12.9)	
	Exhaust		.479 (12.167)	.510 (12.9)	
Valve Lash (Intake & Exhaust)			1 Turn from 0 Lash	3/4 Turn from 0 Lash	
Face Angle (Intake & Exhaust)			45°		
Seat Angle (Intake & Exhaust)			46°		
Seat Runout (Intake & Exhaust)			.002 (0.051) Max.		
Seat Width	Intake		.060 - .090 (1.524 - 2.286)		1/32 - 1/16 (0.8 - 1.6)
	Exhaust		.060 - .090 (1.524 - 2.286)		1/16 - 3/32 (1.6 - 2.3)
Stem Clearance	Production	Intake	.001 - .0027 (0.0254 - 0.0686)		
		Exhaust	.0012 - .0029 (0.0305 - 0.0737)		
	Service	Intake	.0037 (0.0940)		.0037 (0.09)
		Exhaust	.0039 (0.09906)		.0049 (0.12)

Valve Springs:

454 MAGNUM — 8.2 LITRE — 502 MAGNUM			
Valve Spring	Free Length		Outer - 2.21 (60.5) Inner - 2.12 (56.6)
	Pressure (NOTE 1)	Closed @ 1.875 (47.6)	95 lbs. (423 N)
		Open @ 1.365 (34.7)	248 lbs. (1103 N)
	Installed Height		1.88 (47.6)

NOTE 1: Test spring pressure with inner & outer spring assembled.

7.4 LITRE			
Valve Spring	Free Length		2.12 [2-1/8] (54)
	Pressure lbs. @ in. (NOTE 1)	Closed @ 1.80 [1-51/64] (45.7)	74 - 86 lbs. (329 - 383 N)
		Open @ 1.40 [1-13/32] (35.6)	195 - 215 lbs. (867 - 956 N)
	Installed Height		1.875 [1-7/8] (47.6)
Damper	Valve Spring Fit in Damper Shield		.042 - .094 (1.07 - 2.38) Interference

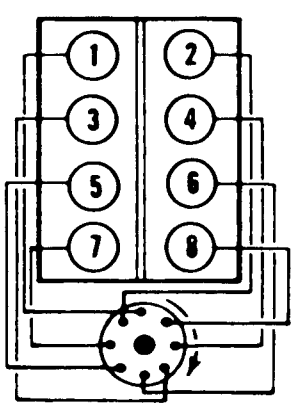
NOTE 1: Test spring pressure with damper shield installed.

Engine Specifications - Generation V Engines

UNIT OF MEASUREMENT in. (mm)

ENGINE MODEL	MCM 7.4 LITRE	MIE 7.4 LITRE	454 MAGNUM
Displacement	454 CID (7.4 Litre)		
Bore	4.25 (107.95)		
Stroke	4.00 (101.6)		
Compression Ratio	8.0:1		8.6:1
Heads	Cast Iron (Oval Port)		Cast Iron (Rectangle Port)
Intake Manifold	Cast Iron		Aluminum Hi-Rise
Block *	Cast Iron (4 Bolt Main Bearing Caps)		
Rods	Forged Steel		
Pistons	Hypereutechtic		Forged Aluminum
Crankshaft	Cast Iron		Forged Steel
Rocker Arms	Stamped Steel		

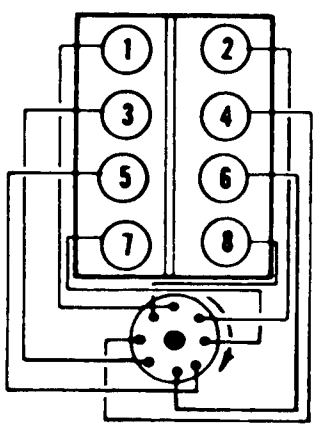
FRONT



Firing Order
1-8-4-3-6-5-7-2

Left-Hand (Standard) Rotation Engine

FRONT



Firing Order
1-2-7-5-6-3-4-8

Right-Hand (Opposite) Rotation Engine

Engine Specifications - Generation V Engines (continued)

ENGINE				7.4 LITRE	454 MAGNUM
Cylinder Bore:					
Diameter				4.2500 - 4.2507 (107.950 - 107.967)	4.2451 - 4.2525 (107.826 - 108.013)
Out of Round	Production			.001 (0.0254) Max.	
	Service			.002 (0.05) Max.	
Taper	Production	Thrust Side		.0005 (0.0127) Max.	
		Relief Side		.001 (0.0254) Max.	
	Service			+ .001 (0.02) Over Production	
Piston:					
Clearance	Production			.0030 - .0042 (0.0762 - 0.1066)	.0025 - .0037 (0.0635 - 0.0939)
	Service			.005 (0.12) Max.	.0075 (0.15) Max.
Piston Ring:					
Compression	Groove Side Clearance	Production	Top	.0012 - .0029 (0.0304 - 0.0736)	.0017 - .0032 (0.0432 - 0.0812)
			2nd	.0012 - .0029 (0.0304 - 0.0736)	.0017 - .0032 (0.0432 - 0.0812)
		Service		+ .001 (0.02) Max.	+ .001 (0.02)
	Gap	Production	Top	.010 - .018 (0.2540 - 0.4572)	
			2nd	.016 - .024 (0.4064 - 0.6096)	
		Service		+ .010 (0.25)	
Oil	Groove Side Clearance	Production		.0050 - .0065 (0.1270 - 0.1651)	
		Service		+ .001 (0.02)	
	Gap	Production		.010 - .030 (0.254 - 0.762)	.020 - .035 (0.508 - 0.889)
		Service		+ .010 (0.25)	
Piston Pin:					
Diameter				.98945 - .98965 (25.1320 - 25.1371)	.9895 - .9898 (25.1333 - 25.1409)
Clearance	Production			.0002 - .0007 (0.0050 - 0.0177)	.00025 - .00035 (0.0064 - 0.0088)
	Service			.001 (0.02) Max.	
Fit in Rod				.0031 - .0021 (0.0787 - 0.0533) Interference	.0008 - .0016 (0.0203 - 0.0406) Interference

Engine Specifications - Generation V Engines (continued)

ENGINE			7.4 LITRE — 454 MAGNUM
Crankshaft:			
Main Journal	Diameter	No. 1, 2, 3, No. 4, 5	2.7482 - 2.7489 (69.8042 - 69.8220)
	Taper	Production	.0002 (0.0051) Max.
		Service	.001 (0.025) Max.
	Out of Round	Production	.0002 (0.0051) Max.
		Service	.001 (0.025) Max.
Main Bearing Clearance	Production	No. 1, 2, 3, 4	.0017 - .0030 (0.0431 - 0.0762)
		No. 5	.0025 - .0038 (0.0635 - 0.0965)
	Service	No. 1, 2, 3, 4	.001 - .003 (0.03 - 0.07)
		No. 5	.0025 - .0040 (0.07 - 0.10)
Crankshaft End Play			.006 - .010 (0.15 - 0.25)
Connecting Rod Journal	Diameter		2.1990 - 2.1996 (55.8546 - 55.8698)
	Taper	Production	.0005 (0.0127) Max.
		Service	.001 (0.025) Max.
	Out of Round	Production	.0005 (0.0127) Max.
		Service	.001 (0.025) Max.
Rod Bearing Clearance		Production	.0011 - .0029 (0.0279 - 0.0736)
		Service	.003 (0.07) Max.
Rod Side Clearance			.002 - .023 (0.05 - 0.58)
Crankshaft Runout			.0015 (0.038) Max. [Check at #3 Main Bearing]

Engine Specifications - Generation V Engines (continued)

ENGINE		7.4 LITRE	454 MAGNUM
Camshaft and Drive:			
Lobe Lift ± .002 (0.051)	Intake	.271 (6.883)	.300 (7.62)
	Exhaust	.282 (7.163)	.300 (7.62)
Duration at .050 in. (1.27mm) Cam Lift	Intake	234°	224°
	Exhaust	238°	224°
Journal Diameter		1.9482 - 1.9492 (49.4842 - 49.5096)	
Journal Out-of-Round		.001 (0.025) Max.	
Camshaft Run-Out		.002 (0.051) Max.	
Timing Chain Deflection [L.H. (Standard) Rotation Engines Only]		3/8 (10) From Taut Position [3/4 (19) Total]	

ENGINE	7.4 LITRE — 454 MAGNUM
Cylinder Head:	
Gasket Surface Flatness	.003 (0.07) in 6 inches (152m), .007 (0.15) Overall Maximum
Flywheel:	
Runout	.009 (0.22) Max.

Engine Specifications - Generation V Engines (continued)

ENGINE			7.4 LITRE	454 MAGNUM
Valve System:				
Lifter Type			Hydraulic	
Rocker Arm Ratio			1.7:1	
Valve Lift		Intake	.461 (11.701)	.510 (12.95)
		Exhaust	.479 (12.167)	.510 (12.95)
Valve Lash (Intake & Exhaust)			Fixed Lash	Fixed Lash
Face Angle (Intake & Exhaust)			45°	
Seat Angle (Intake & Exhaust)			46°	
Seat Runout (Intake & Exhaust)			.002 (0.051) Max.	
Seat Width		Intake	1/32 - 1/16 (0.8 - 1.6)	
		Exhaust	1/16 - 3/32 (1.6 - 2.3)	
Stem Clearance	Production	Intake	.0010 - .0027 (0.0254 - 0.0686)	
		Exhaust	.0012 - .0029 (0.0305 - 0.0737)	
	Service	Intake	.001 (0.02)	
		Exhaust	.002 (0.05)	

454 MAGNUM			
Valve Spring	Free Length		Outer - 2.21 (60.5)
			Inner - 2.12 (56.6)
	Pressure (NOTE 1)	Closed @ 1.875 (47.6)	95 lbs. (423 N)
		Open @ 1.365 (34.7)	248 lbs. (1103 N)
	Installed Height		1.88 [1-7/8] (47.6)

NOTE 1: Test spring pressure with inner & outer spring assembled.

7.4 LITRE			
Valve Spring	Free Length		2.12 [2-1/8] (54)
	Pressure lbs. @ in. (NOTE 1)	Closed @ 1.80 [1-51/64] (45.7)	74 - 86 lbs. (329 - 383 N)
		Open @ 1.40 [1-13/32] (35.6)	195 - 215 lbs. (867 - 956 N)
	Installed Height		1.80 [1-51/64] (45.7)
Damper	Valve Spring Fit in Damper Shield		.042 - .094 (1.07 - 2.38) Interference

NOTE 1: Test spring pressure with damper shield installed.

General

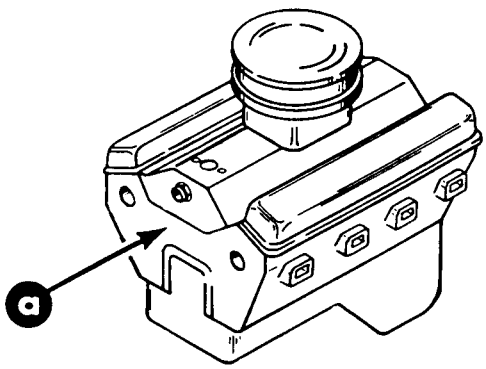
Some repairs, that are listed in this section, must be completed with engine removed from boat. Engine removal depends upon type of repair and boat design. Place engine on repair stand for major repairs.

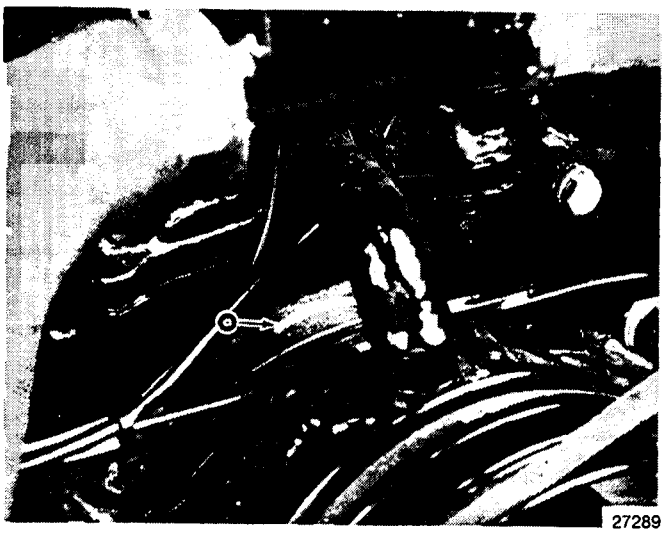
Lubricate all moving parts (during reassembly) with engine oil. Apply Perfect Seal on threads of and under head of cylinder head bolts and on threads of all cylinder block external bolts, screws and studs.

Engine Identification

The MerCruiser Model can be determined by looking at the LAST TWO LETTERS of the engine code stamped into the cylinder block. This code number is stamped on all MerCruiser Power Packages and replacement partial engines but not replacement cylinder block assemblies.

If the engine serial number, and/or model decals are missing, the engine code letters may help in determining the engine model. Following is a list of G.M. engines and their respective code letters.





a - Location of GM engine code for 7.4/8.2 Litre (454/502 CID) engines

MCM (Stern Drive)	Code	Rotation
7.4 Litre	XW (4 bolt main)	LH
454 Magnum	XA (4 bolt main)	LH
502 Magnum	FJ, FH	LH

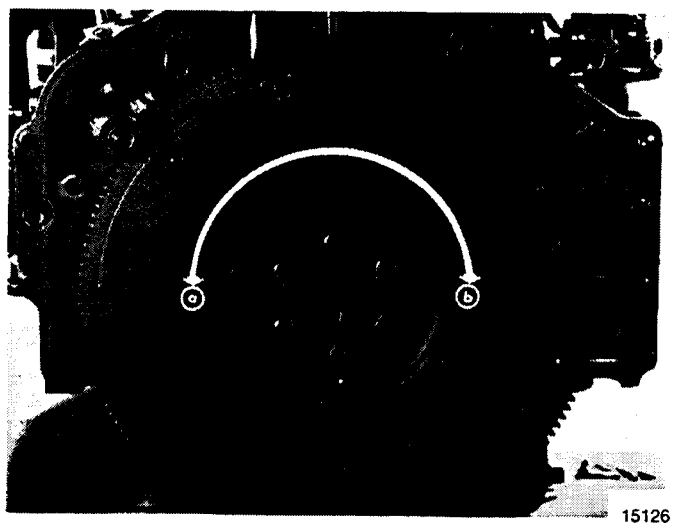
MIE (Inboard)	Code	Rotation
7.4 Litre	XY	LH
7.4 Litre	XZ	RH
8.2 Litre	FH	LH

Engine Rotation

Engine rotation terminology at times has caused confusion. To clarify, engine rotation is determined by observing flywheel rotation from the rear (transmission or stern drive end) of the engine looking forward (water pump end).

PROPELLER ROTATION IS NOT NECESSARILY THE SAME as engine rotation.

When ordering replacement engines, short blocks or parts for engines, be certain to check engine rotation. Do not rely on propeller rotation in determining engine rotation.



a - Left Hand Rotation (CCW) - All Stern Drive Engines, MIE Inboard L.H. (Standard) Rotation
b - Right Hand Rotation (CW) - MIE Inboard R.H. (Opposite) Rotation

Crankshaft

The crankshaft is supported in the block by five insert type bearings. Crankshaft end thrust is controlled by flanges on the number five bearing. A torsional damper on the forward end of the crankshaft serves to help dampen any engine torsional vibration.

Piston and Connecting Rods

Piston pins are offset slightly toward the thrust side of the pistons to provide a gradual change in thrust pressure against the cylinder wall as the piston travels its path. Pins have a floating fit in the piston and a press fit in the connecting rod (to hold them in place).

Connecting rods are made of forged steel and are connected to the crankshaft thru insert type bearings.

Camshaft and Drive

Camshaft is supported by five bearings, which are pressed into the block, and is driven at one-half crankshaft speed by a timing chain and sprockets or by timing gears.

Taper on lobes coupled with spherical foot on hydraulic valve lifters, causes the valve lifters to rotate, thus reducing wear. A helical gear on the aft end of the camshaft drives the distributor and oil pump, while an eccentric cam on the front of the camshaft actuates the fuel pump.

Cylinder Head

The cylinder heads are made of cast iron and have individual intake and exhaust ports for each cylinder.

Stainless steel or graphite composition head gaskets are used to retard corrosion.

Valve Train

The valves and valve springs are of a heavy-duty design to withstand the high engine speeds encountered. Valve tips have been hardened to extend valve life. Exhaust valve rotators are used on all engines except the (production-performance 454 CID engines) to help extend valve life.

Hydraulic valve lifters ride directly on the camshaft lobes and transmit the thrust of the lobes to the push rods which in turn actuate the valves thru the rocker arm.

In addition to transmitting thrust of the cam lobes, the hydraulic lifters also serves to remove any clearance (lash) from the valve train to keep all parts in constant contact.

The valve lifters also are used to lubricate the valve train bearing surfaces.

Intake Manifold

The manifold is of the double level design for efficient fuel distribution. The upper level of passages feeds cylinders 2, 3, 5 and 8 while the lower level passages feed cylinders 1, 4, 6 and 7. All passages are of approximately equal length to assure more even fuel-air mixture to the cylinders.

Lubrication System

The engine lubrication system is of the force-feed type in which oil is supplied under full pressure to the crankshaft, connecting rods, camshaft bearings and valve lifters, and is supplied under controlled volume to the push rods and rocker arms. All other moving parts are lubricated by gravity flow or splash.

A positive displacement gear-type oil pump is mounted on the rear main bearing cap and is driven by an extension shaft from the distributor (which is driven by the camshaft). Oil from the bottom of the pump in the rear of the oil pan is drawn into the oil pump through an oil pickup screen and pipe assembly.

If screen should become clogged, a relief valve in the screen will open and continue to allow oil to be drawn into system. Once the oil reaches the pump, the pump forces the oil thru the lubrication system. A spring loaded relief valve in the pump limits the maximum pump output pressure.

After leaving the pump, the pressurized oil flows thru a full-flow oil filter. On engines with an engine oil cooler, the oil also flows thru the cooler before returning to the block. A bypass valve (on all engines except production-performance 454 CID) allows oil to bypass the filter and oil cooler should they become restricted. A bypass valve is not used on hi-performance 454 CID engines to ensure that all of the oil is filtered.

Some of the oil, after leaving the oil cooler and/or filter, is routed to the main oil gallery, on the left side of the cylinder block, which supplies oil thru individual passages to the No. 1, 2, 3 and 4 crankshaft main bearings and the No. 1, 2, 3 and 4 camshaft bearings. The remainder of the oil is routed to the No. 5 crankshaft main bearing and to an annular groove in the No. 5 camshaft bearing bore. Some of the oil is then used to lubricate the camshaft bearing, while the remainder is routed to both valve lifter oil galleries thru oil passages which intersect the annular groove.

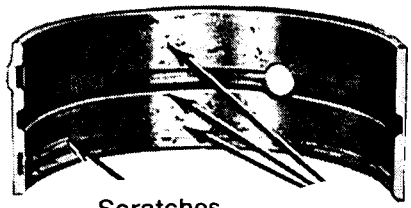
The camshaft bearings have holes which align with the oil passages or annular grooves in the block and allow oil to flow in between the bearings and the camshaft journals. The oil that is forced out the front end of the No. 1 camshaft bearing drains down onto camshaft drive and keeps it lubricated.

The oil which reaches the crankshaft main bearings is forced thru a hole in the upper half of each bearing and flows in-between the bearings and the crankshaft journals. Some of the oil is then routed to the connecting rod bearings thru grooves in the upper half of the crankshaft main bearings and oil passages in crankshaft. Oil which is forced out the ends of the connecting rod bearings and crankshaft main bearings is splashed onto the camshaft, cylinder walls, pistons and piston pins, keeping them lubricated. Oil which is forced out the front end of the No. 1 crankshaft main bearing also assists in lubricating the camshaft drive. A baffle plate, mounted on the bottom of the main bearings or in the oil pan, prevents oil thrown from the crankshaft and connecting rods from areating the oil in the oil pan.

Oil which reaches the valve lifters oil galleries is forced into each hydraulic valve lifter thru holes in the side of the lifter. From here, the oil is forced thru the metering valve in each of the lifters (which controls the volume of oil flow) and then up thru the push rods to the rocker arms. A hole in each rocker arm push rod seat allows the oil to pass thru the rocker arm and lubricate the valve train bearing surfaces. After lubricating valve train, oil drains back to the oil pan thru oil returns holes in the cylinder head and block.

The distributor shaft and gear also is lubricated by the oil flowing thru the right valve lifter oil gallery. Fuel pump push rod is lubricated by oil thrown off from the camshaft eccentric.

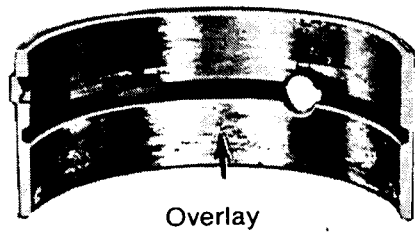
Bearing Failures



Scratches

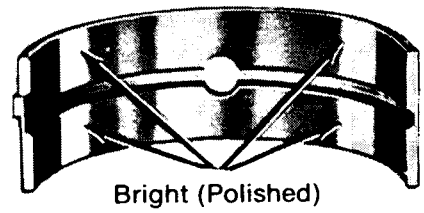
Dirt Imbedded into Bearing Material

SCRATCHED BY DIRT



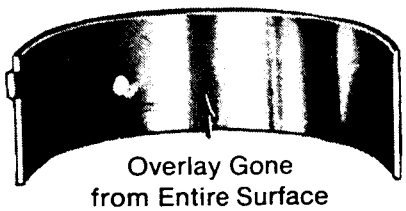
Overlay Wiped Out

LACK OF OIL



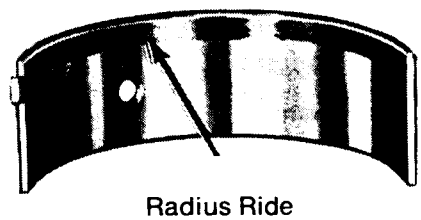
Bright (Polished) Sections

IMPROPER SEATING



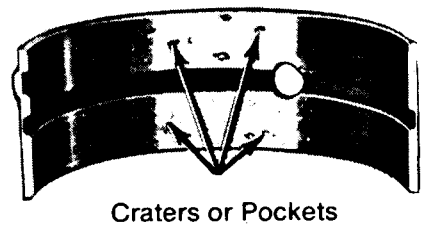
Overlay Gone from Entire Surface

TAPERED JOURNAL



Radius Ride

RADIUS RIDE



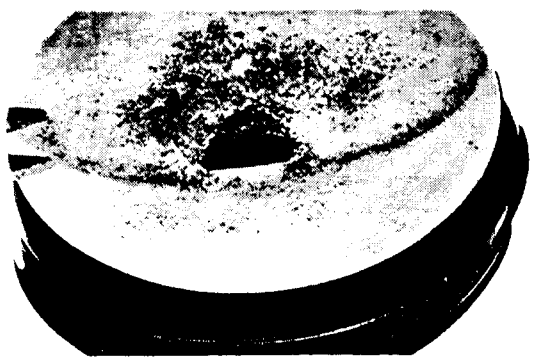
Craters or Pockets

FATIGUE FAILURE

Piston Failures

Pre-Ignition

Pre-ignition is abnormal fuel ignition, caused by combustion chamber hot spots. Control of the start of ignition is lost, as combustion pressure rises too early, causing power loss and rough running. The upward motion of the piston is opposed by the pressure rise. This can result in extensive damage to the internal parts from the high increase in combustion chamber temperature.

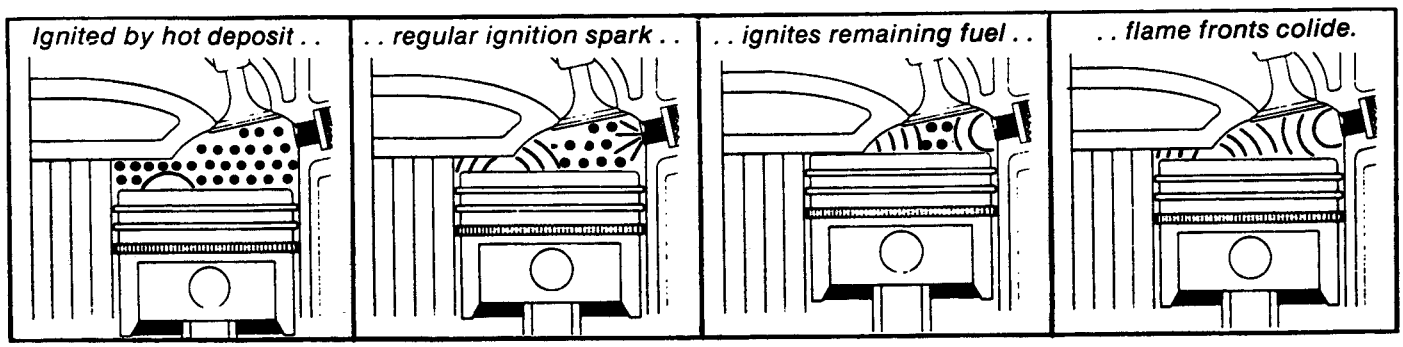


Pre-Ignition Damage

Pre-Ignition Causes

1. Hot spots in the combustion chamber from glowing deposits (due in turn to the use of improper oils and/or fuels).
2. Overheated spark plug electrodes (improper heat range or defective plug).
3. Any other protuberance in the combustion chamber, such as an overhanging piece of gasket, an improperly seated valve or any other inadequately cooled section of material which can serve as a source.

Engine failures, which result from the foregoing conditions, are beyond the control of Mercury Marine, therefore, no warranty will apply to failures which occur under these conditions.



Detonation

Detonation, commonly called "fuel knock," "spark knock" or "carbon knock," is abnormal combustion of the fuel which causes the fuel to explode violently. The explosion, in turn, causes overheating or damage to the spark plugs, pistons, valves and, in severe cases, results in pre-ignition.

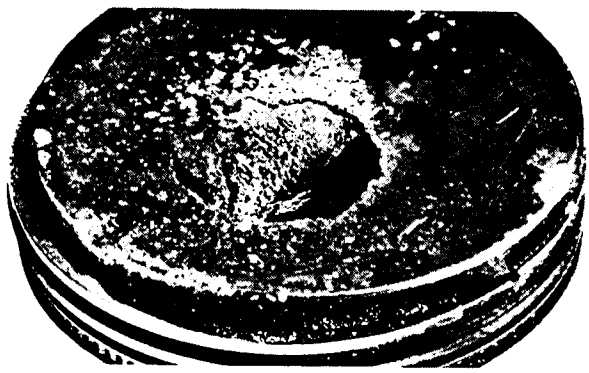
Use of low octane gasoline is one of the most common causes of detonation. Even with high octane gasoline, detonation could occur if engine maintenance is neglected.

OTHER CAUSES of DETONATION

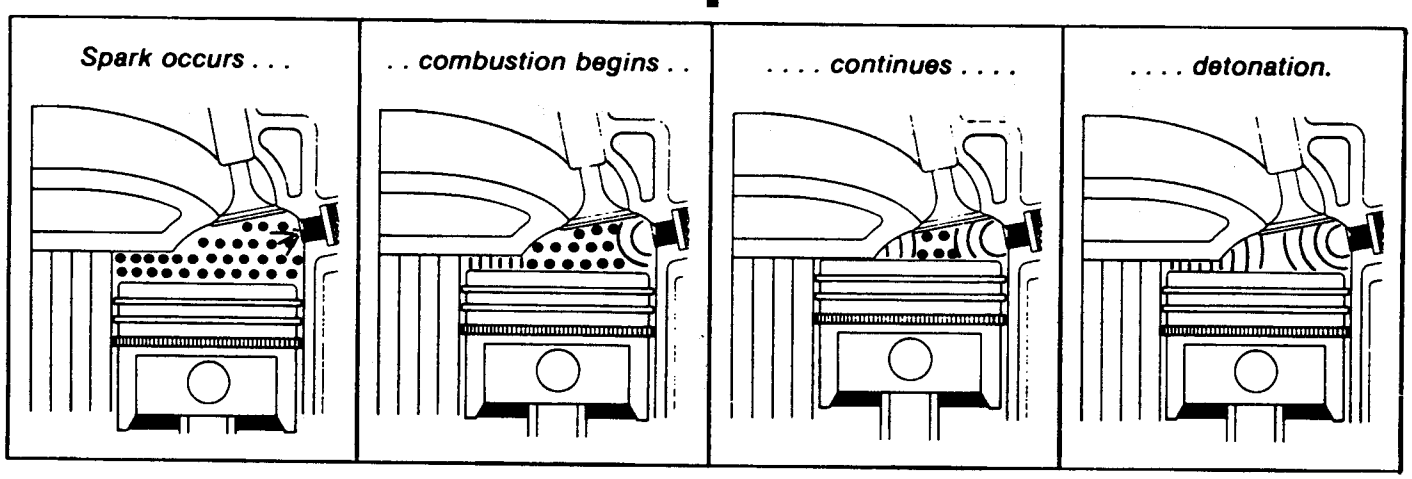
IMPORTANT: Use of improper fuels will cause engine damage and poor performance.

1. Over-advanced ignition timing.
2. Lean fuel mixture at or near full throttle (could be caused by carburetor or leaking intake manifold).
3. Cross-firing spark plugs.
4. Excess accumulation of deposits on piston and/or combustion chamber (results in higher compression ratio).
5. Inadequate cooling of engine by deterioration of cooling system.

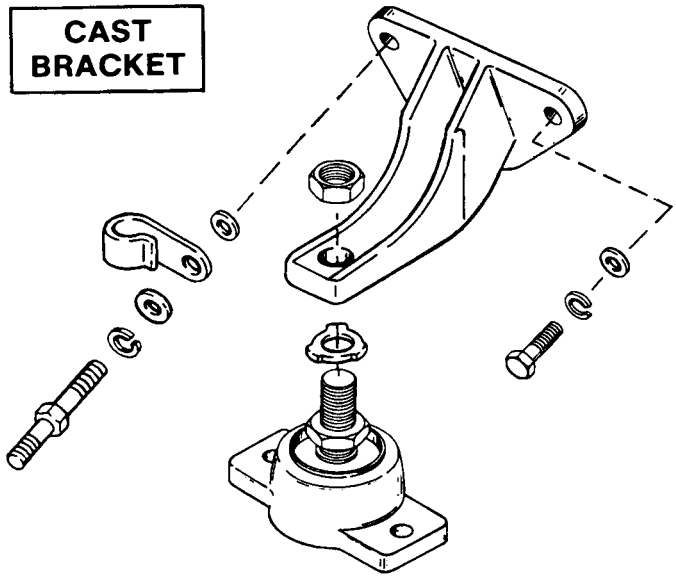
Engine failures, which result from the foregoing conditions, are beyond the control of Mercury Marine, therefore, no warranty will apply to failures which occur under these conditions.



Detonation Damage



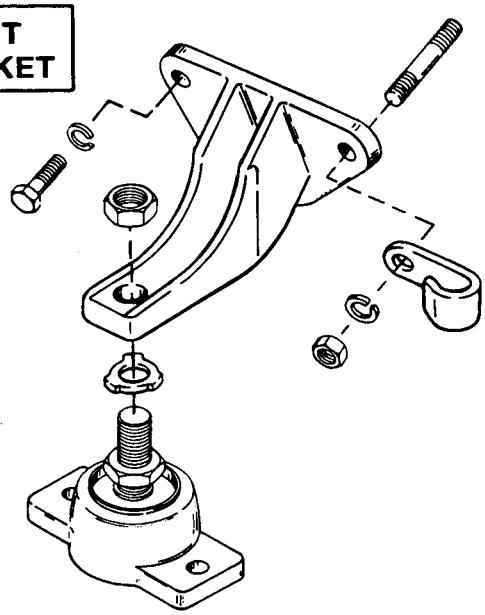
CAST BRACKET



454 MAGNUM BRAVO ENGINE

Front Mount

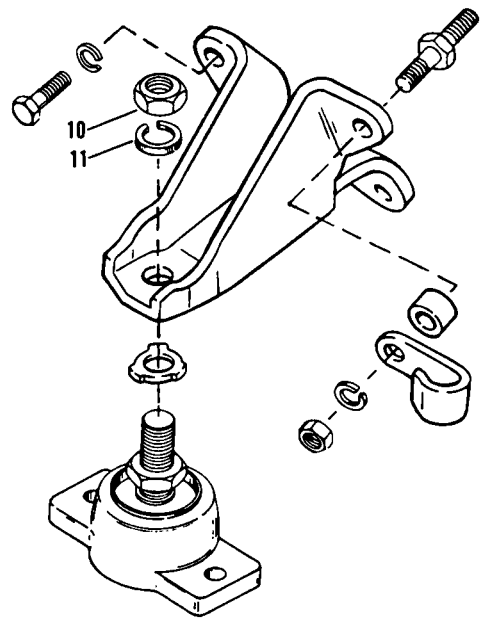
CAST BRACKET



454 MAGNUM ALPHA ONE ENGINE

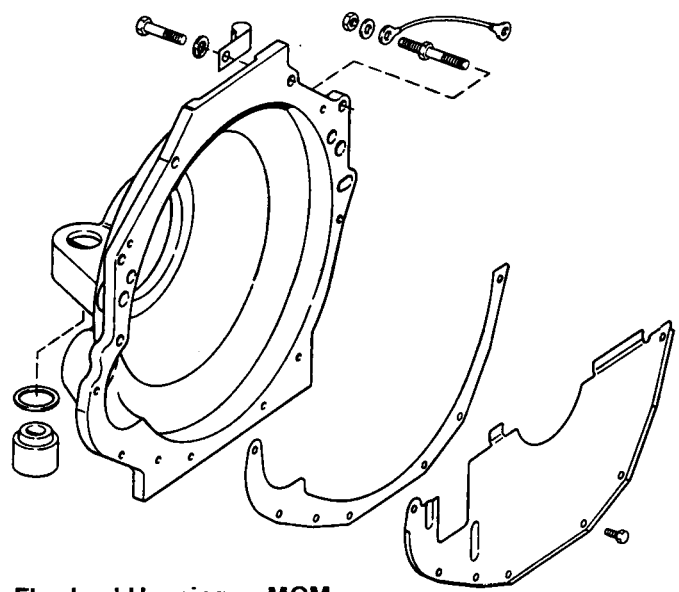
Front Mount

STAMPED BRACKET

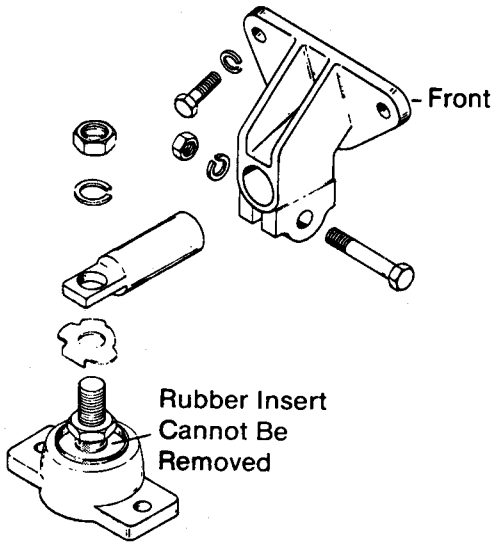


454 MAGNUM ALPHA ONE ENGINE

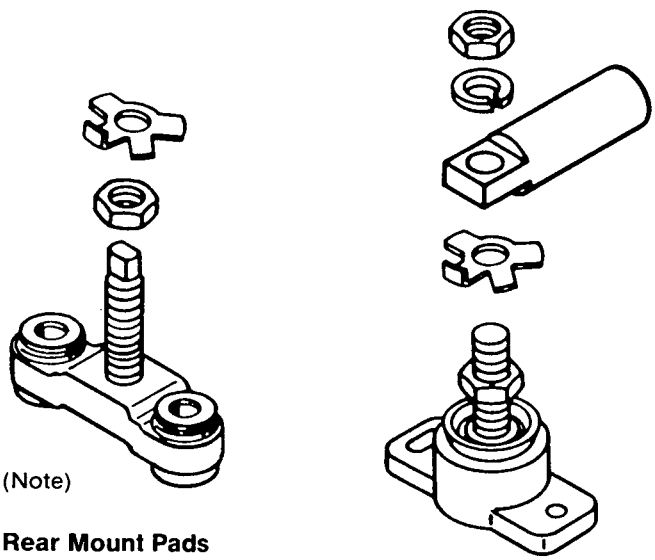
Front Mount



Flywheel Housing — MCM

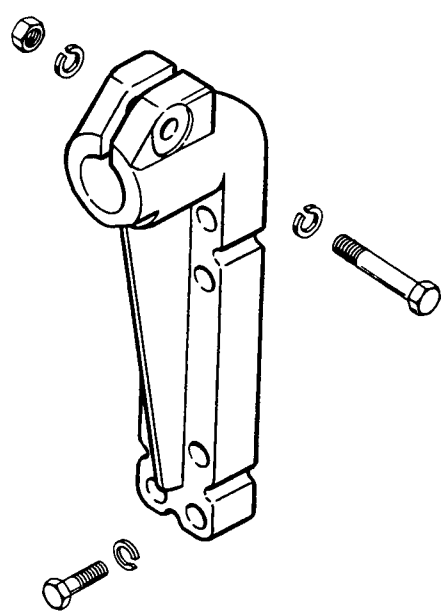


Front Mount — MIE

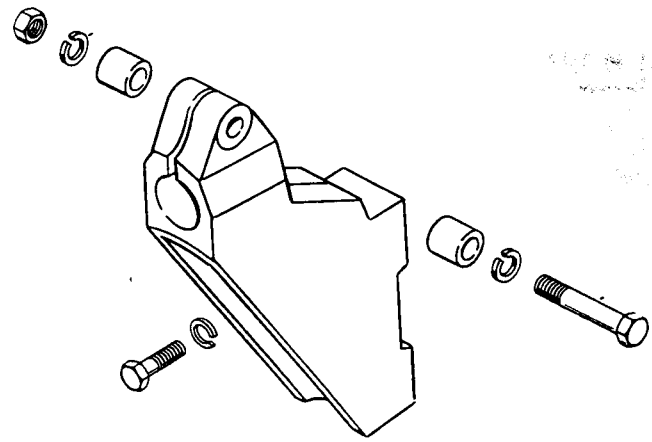


Rear Mount Pads

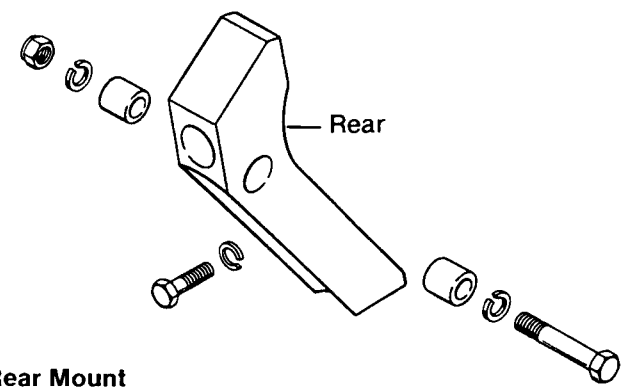
(NOTE: Longer retaining fastener required.)



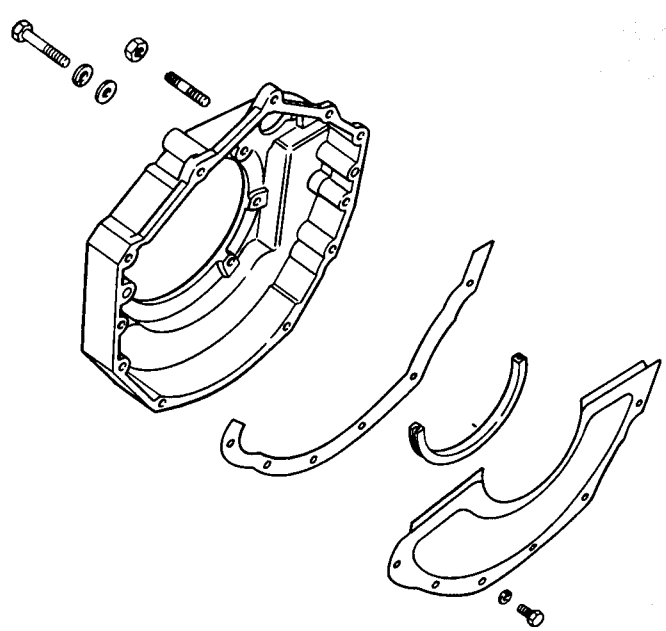
Rear Mount
Hurth Down Angle and V-Drive Transmission



Rear Mount
Borg Warner In-Line Transmission



Rear Mount
Borg Warner V-Drive Transmission



FLYWHEEL HOUSING - MIE

Rocker Arm Cover

NOTE: Generation V Engines have cast aluminum rocker arm covers in place of stamped steel Mark IV covers.

Removal

1. Remove exhaust manifolds and anything attached to them.
2. Disconnect crankcase ventilation hoses.

IMPORTANT: Do not pry rocker covers loose. Gaskets, which adhere to cylinder heads and rocker arm covers, may break loose by bumping end of rocker cover with palm of hand or a rubber mallet.

3. Remove rocker arm cover.

Installation

1. Clean sealing surfaces on cylinder head and rocker arm cover with degreaser.
2. Install rocker arm covers, as follows:

ROCKER ARM COVERS USING GASKETS or PRE-SHAPED O-RING SEAL:

a. Place new rocker arm cover gasket or pre-shaped O-ring seal in position in rocker arm cover.

b. Install rocker arm cover. Secure with reinforcements, if so equipped, and attaching screws or nuts. Torque to 115 lb. in. (13 N·m), except on Generation V engines which torque to 70 lb. in. (8 N·m).

ROCKER ARM COVERS USING RTV SEALER:

a. Apply a 3/16" (5mm) wide bead of RTV Sealer all-the-way around sealing surface on cylinder head, making sure to apply sealer on inboard side of attaching screw holes or studs.

IMPORTANT: Be sure to install valve rocker arm cover while sealer is still wet. Sealer dries in approximately 15 minutes.

b. Install rocker arm cover and secure with attaching screws or nuts. Torque to 115 lb. in. (13 N·m).

3. Install crankcase ventilation hoses.
4. Install exhaust manifolds and anything attached to them.

Intake Manifold

Removal

1. Drain engine cooling system.
2. Disconnect hoses from thermostat housing.
3. Disconnect intake manifold to circulating pump bypass hose from circulating pump.
4. Disconnect wire from water temperature sending unit. On some engines, it may be necessary to remove sending unit to allow removal of manifold attaching screw.
5. Disconnect crankcase ventilation hoses from rocker arm covers.
6. Disconnect throttle cable from carburetor. Remove fuel line running between fuel pump and carburetor.

IMPORTANT: Do not crank engine over after distributor has been removed.

7. Remove distributor cap and mark position of rotor on distributor housing. Also, mark position of distributor housing on intake manifold. Remove distributor.
8. Remove other ignition components.
9. Disconnect any other items that will prevent removal of manifold.

IMPORTANT: It may be necessary to pry intake manifold away from cylinder heads and block, in next step. Use extreme care to prevent damage to sealing surfaces.

10. Remove intake manifold screws, then remove intake manifold and carburetor assembly.

NOTE: If intake manifold requires replacement, transfer carburetor and other related parts to new manifold.

Cleaning and Inspection

1. Clean gasket material from all mating surfaces.

IMPORTANT: When cleaning cylinder head mating surface, do not allow gasket material to enter engine crankcase.

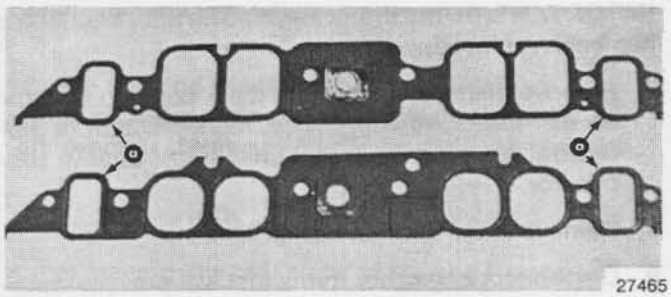
2. Inspect manifold for cracks or scratches. Machined surfaces must be clean and free of all marks, or deep scratches or leaks may result.
3. Check intake passages for varnish buildup or other foreign material. Clean as necessary.

Installation

IMPORTANT: When installing intake manifold gaskets, in next step, be sure to do the following:

- **All MerCruiser V-8 G.M. engines that have "automatic" carburetor chokes must use an intake gasket that has an opening for the exhaust crossover port in the intake manifold. Without this opening the "automatic" carburetor choke will not operate properly. The choke will remain "On" longer causing rough engine operation and wasted fuel.**

1. Apply Perfect Seal to both sides of intake manifold gasket around coolant passages (a).



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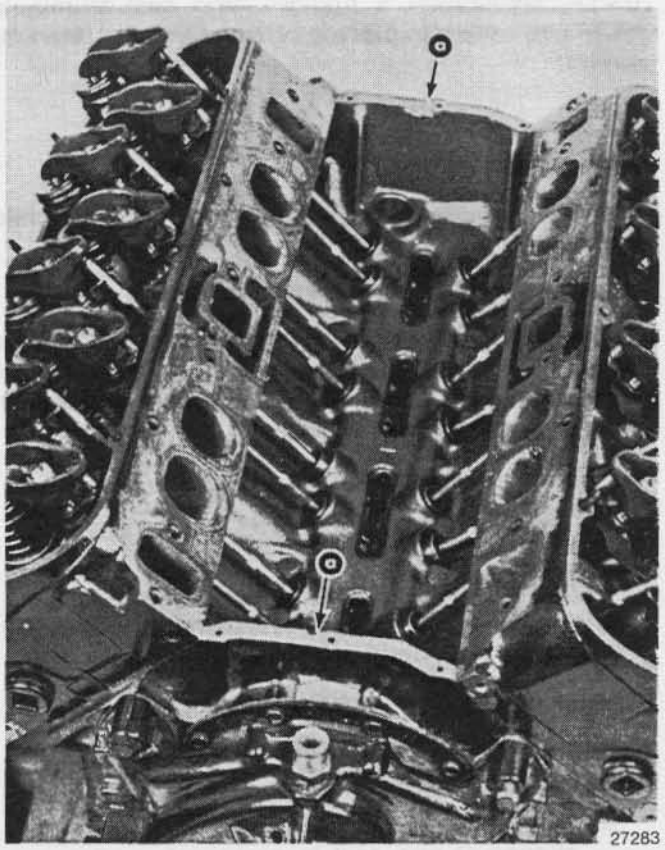
454 MAGNUM
502 MAGNUM

7.4 LITRE
8.2 LITRE

2. Using Bellows Adhesive, glue rubber gaskets to engine block between cylinder heads (a).



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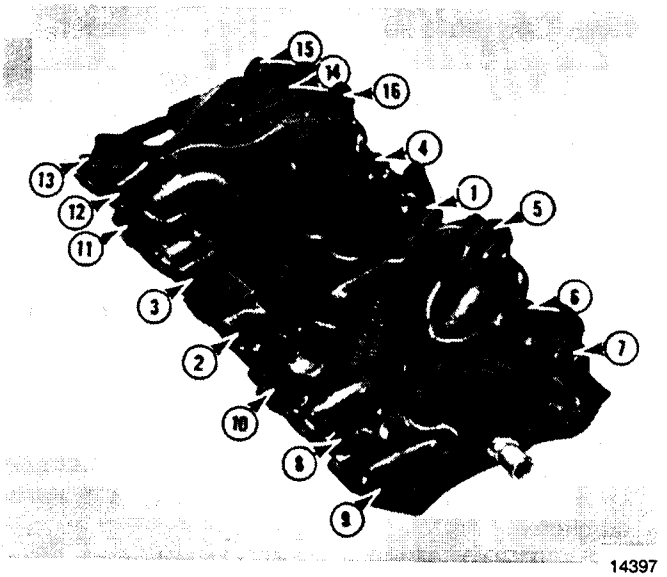
3. Apply a small amount of RTV Sealer on rubber gasket ends.
4. Set intake manifold gaskets in place, aligning bolt holes.

5. Carefully install intake manifold and torque bolts to 30 lb. ft. (41 N·m) in sequence shown.



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6. Connect intake manifold to circulating pump by-pass hose.
7. Connect wire to water temperature sending unit.
8. Reconnect hoses to thermostat housing.
9. Install fuel line to carburetor and fuel pump. Connect throttle cable to carburetor.
10. Connect crankcase ventilation hoses to rocker arm covers.
11. Install distributor. Position rotor and housing to align with marks made during removal, then install distributor cap.
12. Install other ignition components and reconnect wires.
13. Reconnect any other items which were disconnected from manifold during the removal.
14. Start engine. Adjust ignition timing and carburetor. Check hose connections, gaskets and seals for leaks.
15. Inspect fuel line connections for fuel leaks.

Rocker Arm/Push Rod

Removal

NOTE: When servicing only one cylinder's rocker arms, bring that cylinder's piston up to TDC before removing rocker arms. When servicing all rocker arms, bring number 1 piston up to TDC before removing rocker arms.

1. Remove rocker arm covers as outlined.
2. Remove rocker arm assemblies and push rods.

IMPORTANT: Place rocker arm assemblies and push rods in a rack for reassembly in their original locations.

Cleaning and Inspection

1. Clean parts with solvent and dry with compressed air.
2. Inspect all contact surfaces for wear. Replace all damaged parts.

Installation

IMPORTANT: When installing rocker arms and rocker arm balls, coat bearing surfaces of rocker arms and rock arm balls with engine oil.

1. Install push rods in their original locations. Be sure push rods seat in lifter socket.
2. Install rocker arms, rocker arm balls and rocker arm nuts in their original locations.
3. Follow instructions "a" or "b":
   a. **On Mark IV Engines (stamped steel rocker arm covers):** Adjust valves as outlined under "Valve Adjustment - Engine Stopped."
   b. **On Generation V Engines (cast aluminum rocker arm covers):** Torque rocker arm bolts to 45 lb. ft. (61 N·m). No valve adjustment is needed.

Valve Adjustment

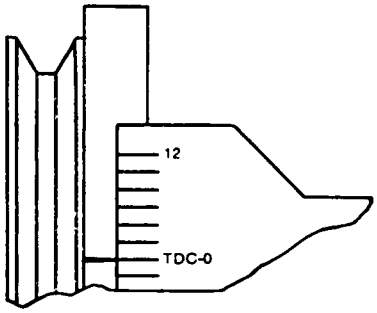
IMPORTANT: Engines with cast aluminum valve covers (Generation V Engines) do not require valve adjustment. Valves are adjusted when rocker arm bolts are torqued to specifications.

Valve Adjustment - Engine Stopped (Engines with Stamped Steel Valve Covers)

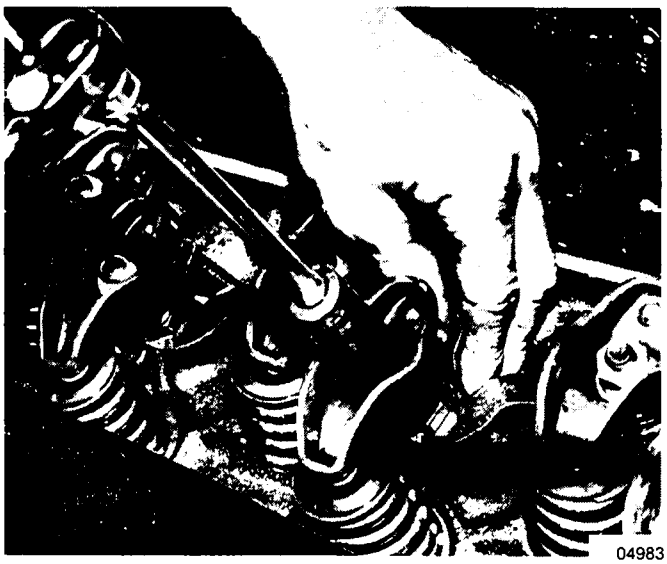
With valve cover removed, adjust valves when lifter is on low part of camshaft lobe, as follows:

1. Crank engine with starter or turn over in normal direction of rotation until mark on torsional damper lines up with center "O" mark on timing tab, and engine is in No. 1 firing position. This may be determined by placing fingers on No. 1 valve as mark on damper comes near "O" mark on timing mark. If valves move as mark comes up to timing tab, engine is in No. 6 firing position and should be turned over one more time to reach No. 1 position.

2. With engine in No. 1 firing position as determined above, the following valves may be adjusted.



3. **MCM and MIE Left Hand (Standard) Rotation Engines:**
   Exhaust - 1-3-4-8 Intake - 1-2-5-7
   MIE Right Hand (Opposite) Rotation Engines:
   Exhaust - 1-2-5-7 Intake - 1-3-4-8
4. Back out adjusting nut until lash is felt at push rod, then turn in adjusting nut until all lash is removed. This can be determined by moving push rod up-and-down while turning adjusting nut until all play is removed.



Valve Adjustment

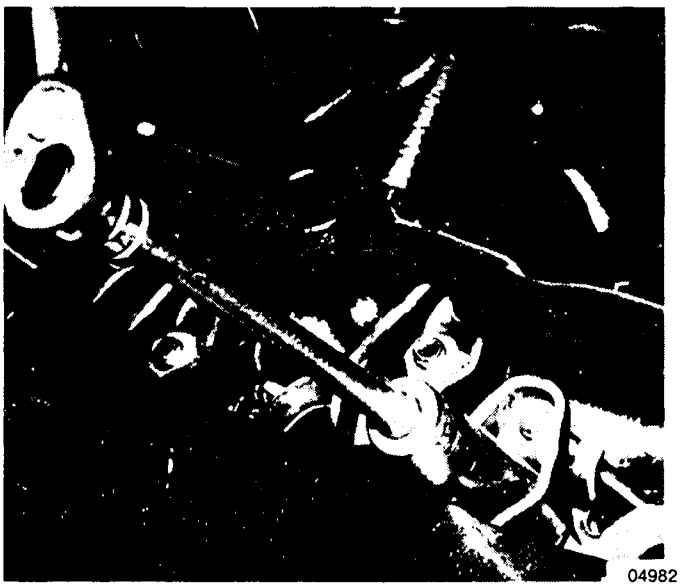
5. Hydraulic lifters now can be adjusted by tightening adjustment nut an additional 1-turn. No other adjustment is required.
6. Crank engine one revolution until pointer "O" mark and torsional damper mark are again in alignment. This is No. 6 firing position. With engine in this position, the following valves may be adjusted as previously outlined.
7. **MCM and MIE Left Hand (Standard) Rotation Engines:**
   Exhaust - 2-5-6-7 Intake - 3-4-6-8

   MIE Right Hand (Opposite) Rotation Engines:
   Exhaust - 3-4-6-8 Intake - 2-5-6-7

Valve Adjustment - Engine Running (Engines with Stamped Steel Valve Covers)

IMPORTANT: Engines with cast aluminum valve covers (Generation V Engines) do not require valve adjustment. Valves are adjusted when rocker arm bolts are torqued to specification.

1. Run engine to normal operating temperature.
2. Remove rocker arm covers as outlined.
3. Install rocker stoppers to prevent hot oil from spraying out of rocker arms.
4. Reinstall exhaust manifolds and anything else that is needed so engine will run.
5. With engine running at idle, back valve rocker arm nuts off (one at a time) until valve rocker arm starts to clatter.
6. Turn rocker arm nut down until clatter just stops. This is zero lash position.
7. Turn nut down 1/4 additional turn and pause 10 seconds until engine runs smoothly. Repeat until nut has been turned down 1-turn from the zero lash position.



IMPORTANT: This 1-turn preload adjustment must be done slowly to allow the lifter to adjust itself and prevent the valves from hitting the pistons, causing internal damage and/or bent push rods.

8. Repeat Steps 5-6-7 to adjust other valves.
9. Remove rocker stoppers after all valves are adjusted.
10. Remove exhaust manifolds.
11. Install rocker arm covers as outlined.
12. Install exhaust manifolds and anything attached to them.

Hydraulic Valve Lifters

Hydraulic valve lifters require little attention. Lifters are extremely simple in design. Normally, readjustments are not necessary and servicing requires only that care and cleanliness be exercised in the handling of parts.

Generation V Engines, those with cast aluminum valve covers, do not require readjustment after rocker arm bolts are torqued to specification upon installation.

Locating Noisy Lifters

Locate a noisy valve lifter by using a piece of garden hose approximately 4 ft. (1.2m) in length. Place one end of hose near end of each intake and exhaust valve, with other end of hose to the ear. In this manner, sound is localized, making it easy to determine which lifter is at fault.

Another method is to place a finger on face of valve spring retainer. If lifter is not functioning properly, a distinct shock will be felt when valve returns to its seat.

General types of valve lifter noise are as follows:

1. **Hard rapping noise** -- Usually caused by plunger becoming tight in bore of lifter body so that return spring cannot push plunger back up to working position. Probable causes are:
   a. Excessive varnish or carbon deposit, causing abnormal stickiness.
   b. Galling or "pick-up" between plunger and bore of lifter body, usually caused by an abrasive piece of dirt or metal wedged between plunger and lifter body.
2. **Moderate rapping noise** -- Probable causes are:
   a. Excessively high leakdown rate.
   b. Leaky check valve seat.
   c. Improper adjustment, or loose rocker arm bolt on Generation V engines.
3. **General noise throughout valve train** -- This will, in most cases, be a definite indication of insufficient oil supply or improper adjustment.
4. **Intermittent clicking** -- Probable causes are:
   a. A microscopic piece of dirt momentarily caught between ball seat and check valve ball.
   b. In rare cases, ball itself may be out-of-round or have a flat spot.
   c. Improper adjustment.

In most cases, where noise exists in one or more lifters, all lifter units should be removed, disassembled, cleaned in solvent, reassembled and reinstalled in engine. If dirt, corrosion, carbon, etc., is shown to exist in one unit, it more likely exists in all the units, thus it would only be a matter of time before all lifters caused trouble.

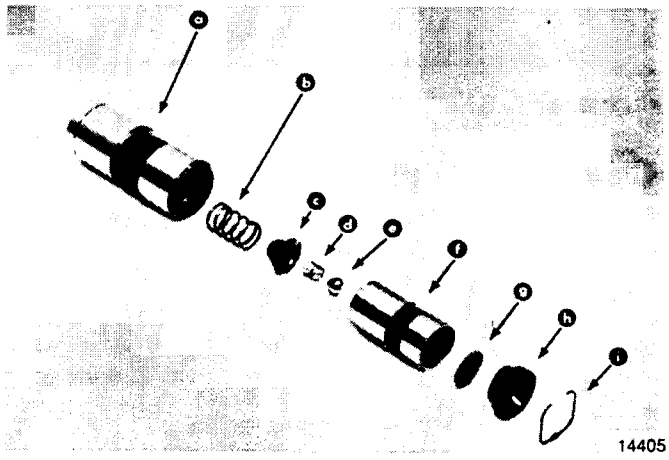
Removal

IMPORTANT: Keep rocker arm assemblies, push rods, and lifters in order so they can be reinstalled in their original locations.

Remove as outlined:

a. Rocker arm covers
b. Rocker arm assemblies and push rods
c. Intake manifold
d. Hydraulic lifters.

Hydraulic Valve Lifter (Exploded view)



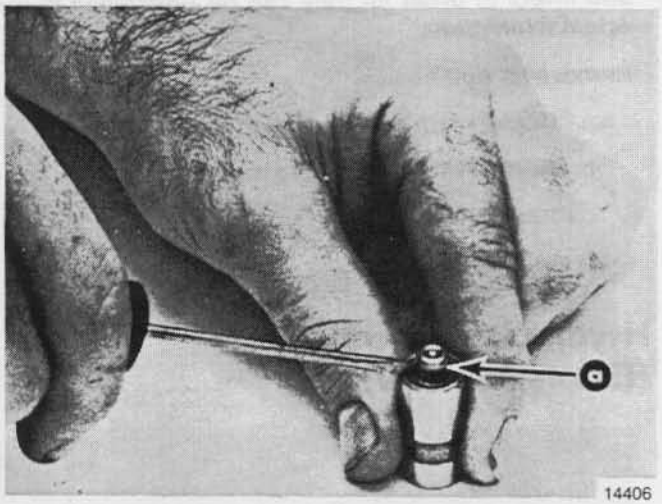
a - Lifter Body
b - Plunger Spring
c - Check Ball Retainer
d - Check Ball Spring
e - Check Ball
f - Plunger
g - Metering Valve
h - Push Rod Seat
i - Push Rod Seat Retainer

Disassembly

IMPORTANT: The internal parts of each hydraulic lifter assembly are matched sets. Do not intermix the parts.

1. Hold plunger down with a push rod and remove push rod seat retainer with the blade of a small screwdriver.
2. Remove push rod seat and metering valve.
3. Remove the plunger, ball check valve assembly and the plunger spring.

4. Remove the ball check valve and spring by prying the ball retainer loose from the plunger with the blade of a small screwdriver.



a - Check Ball Retainer

Cleaning and Inspection

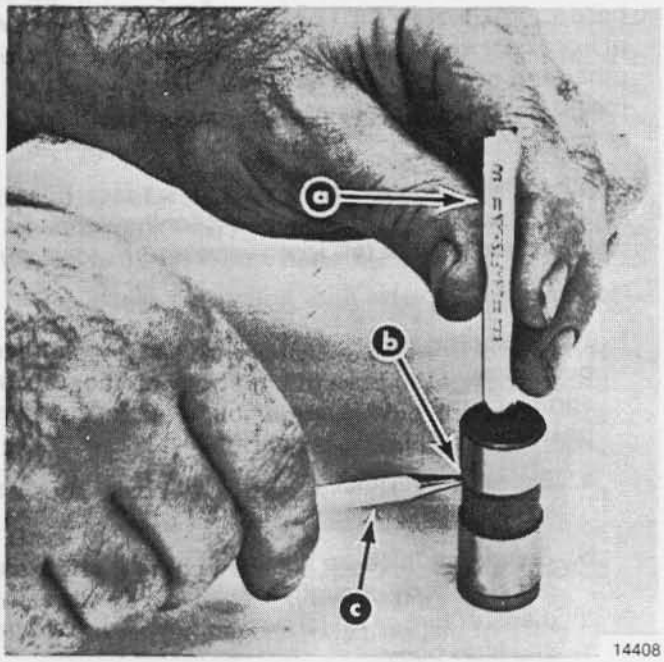
Thoroughly clean all parts in cleaning solvent and inspect them carefully. If any parts are damaged or worn, entire lifter assembly should be replaced. If outer lifter body wall is scuffed or worn, inspect cylinder block lifter bore. If bottom of lifter is scuffed or worn, inspect camshaft lobe. If push rod seat is scuffed or worn, inspect push rod.

Reassembly

1. Place the check ball in small hole in bottom of the plunger.
2. Insert check ball spring on seat in ball retainer and place retainer over ball so that spring rests on the ball. Carefully press the retainer into position in plunger with the blade of a small screwdriver.

a - Check Ball Retainer

3. Place the plunger spring over the ball retainer and slide the lifter body over the spring and plunger, being careful to line up the oil feed hole in the lifter body and plunger.
4. Fill the assembly with oil, then insert the end of a 1/8 in. drift pin into the plunger and press down on check ball until hole in lifter body aligns with hole in plunger.
5. Insert a 1/16 in. drift pin through both oil holes to hold the plunger down against the lifter spring tension.



a - 1/8 in. Drift Pin
b - Oil Feed Hole
c - 1/16 in. Drift Pin

Oil Feed Holes Aligned and Drift Pin Installed

IMPORTANT: Do not attempt to force or pump the plunger.

6. Remove the 1/8 in. drift pin and refill assembly with oil.
7. Install the metering valve, push rod seat and push rod seat retainer.
8. Press down on the push rod seat with a push rod and remove 1/16 in. drift pin from lifter. The lifter is now completely assembled, filled with oil and ready for installation.

Installation

IMPORTANT: It is recommended that the engine oil be changed and a new oil filter be installed whenever servicing valve lifters or camshaft.

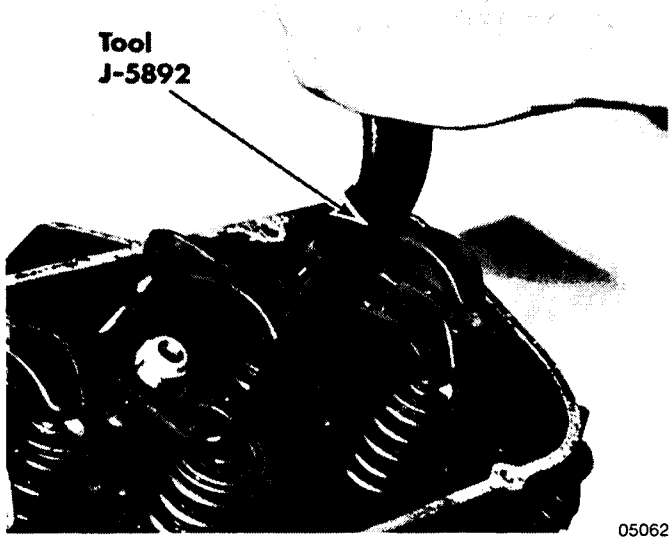
IMPORTANT: Before installation, coat entire valve lifter with engine oil. DO NOT install used valve lifters if a new camshaft has been installed.

1. Coat valve lifters with engine oil.
2. Install as outlined:
   a - Valve Lifters
   b - Push Rods
   c - Rocker Arm Assemblies
3. Adjust valves as outlined under "Valve Adjustment - Engine Stopped (Engines with Stamped Steel Valve Covers)."
4. Install as outlined:
   a - Intake Manifold
   b - Rocker Arm Covers
   c - All Accessories Removed During Disassembly
5. With engine running, set timing, idle mixture screws, and idle speed. Check for leaks.

Valve Stem Oil Seal/ Valve Spring

Removal - Head Installed

1. Remove as outlined:
   a. Rocker arm cover.
   b. Spark plug, rocker arm and push rod on cylinder(s) to be serviced.
2. Install air line adapter tool J-23590 in spark plug hole and apply compressed air to hold valves in place.
3. Compress valve spring, using Tool J-5892. Remove valve locks and slowly release tool.



05062

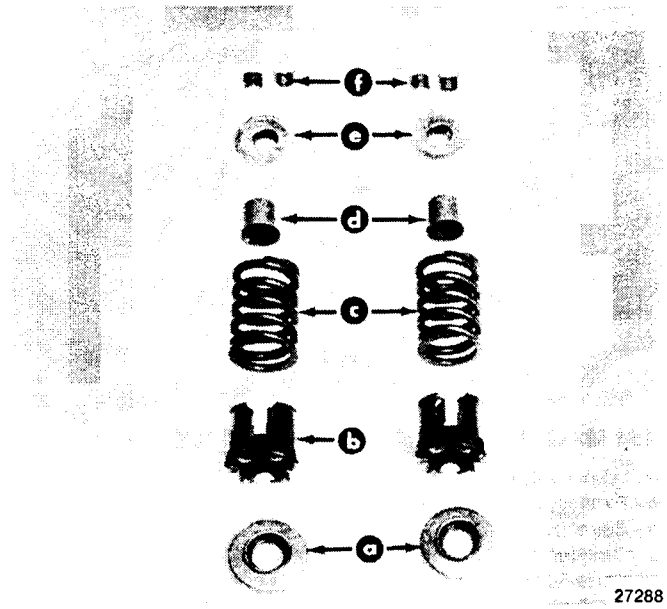
a - Tool J-5892
b - Rocker Arm Nut

4. Remove spring cap, valve seal, valve spring, and shim or rotator.

NOTE: Heads may come with rotators or shims or a combination of both. Reassemble heads with rotators and/or shims in their original locations.

IMPORTANT: Keep air pressure in cylinder while springs, caps, and valve locks are removed or valves will fall into cylinder.

Valve Spring and Seal Assembly (Exploded view)



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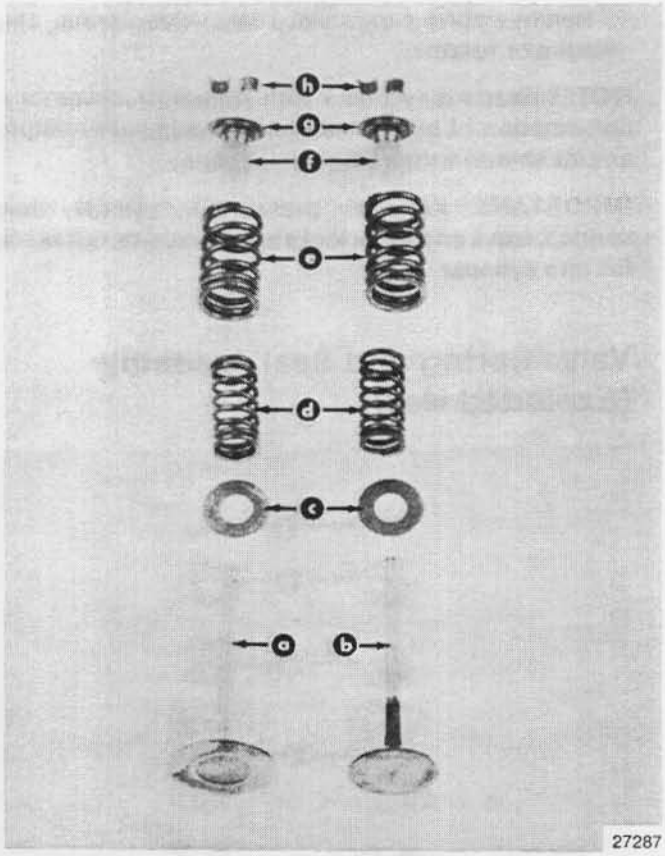
7.4 LITRE (Intake or Exhaust Valve)

a - Rotator
b - Shield
c - Valve Spring
d - Oil Seal
e - Cap
f - Valve Lock



27287

454 MAGNUM/502 MAGNUM/8.2 LITRE

a - Intake Valve
b - Exhaust Valve
c - Shim
d - Damper (Inner Spring)
e - Valve Spring (Outer)
f - Oil Seal — One Assembly
g - Cap — One Assembly
h - Valve Lock

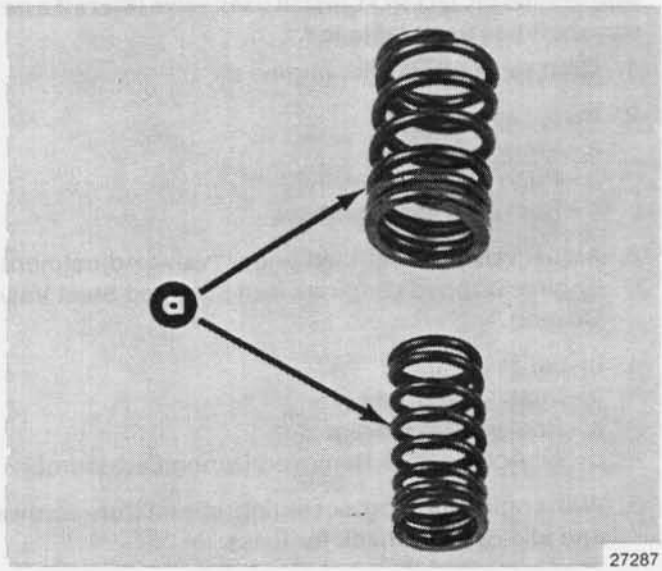
Installation - Head Installed

7.4 Litre

1. Place rotator or shim on valve spring seat.
2. Coat valve stem and new seal with engine oil. Install seal over valve stem.
3. If taken apart, reassemble damper and valve spring. Place on top of rotator or shim.
4. Set valve spring assembly and cap in position over valve stem.
5. Compress spring, using tool J-5892, and install keys (grease may be used to hold keys in place). Slowly release tool, making sure keys seat properly in valve stem grooves.

454 Magnum/502 Magnum/8.2 Litre

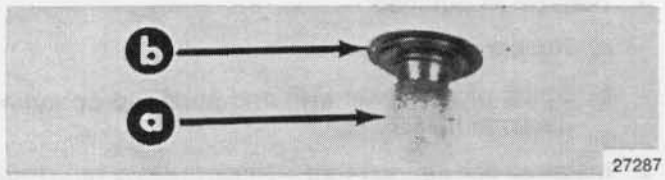
1. Place shim on valve spring seat.
2. If taken apart, reassemble damper and valve spring as shown. Make sure tighter wound coils (a) of spring and damper are on the same end.



27287

3. Place valve spring assembly in position with tighter wound coils against spring seat.

IMPORTANT: Valve seal (a) and cap (b) must be assembled as shown before installation.



27287

4. Coat valve stem and new seal with engine oil.
5. Set cap and seal assembly on valve stem. Align valve stem with center of valve seal.
6. Compress valve spring, using tool J-5892, and install keys (grease may be used to hold keys in place). Slowly release tool to prevent damaging seal. Make sure keys seat properly in valve stem grooves.

Cylinder Head

Removal

1. Drain engine cooling system.
2. Remove as outlined:
   a. Exhaust manifolds
   b. Intake manifold
   c. Rocker arm covers
   d. Rocker arm assemblies and push rods (keep in order for reassembly in their original locations)
   e. Any components attached to front or rear of cylinder head
   f. Spark plugs
   g. Head bolts

⚠CAUTION
The head gasket may be holding cylinder head to block. Use care when prying off cylinder heads. DO NOT damage gasket surfaces. DO NOT drop cylinder heads.

3. Place cylinder head on wooden blocks to prevent damage to gasket surfaces.

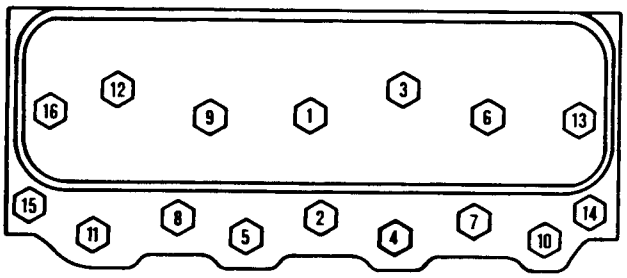
Cleaning and Inspection

Clean gasket material and sealer from engine block and cylinder heads. Inspect sealing surfaces for deep nicks and scratches. Look for corrosion around cooling passages. Clean head bolt threads and engine block bolt hole threads.

Installation

⚠CAUTION
When using ribbed stainless steel head gaskets, apply a thin coating of Perfect Seal to both sides of gasket. Too much sealer may hold gasket away from head or block causing leakage. DO NOT use sealer on graphite composition head gaskets.

1. Place head gasket in position over dowel pins.
2. Carefully set cylinder head in place on dowel pins.
3. Coat threads of head bolts with Perfect Seal and install finger-tight.
4. To insure gasket sealing, torque head bolts in three steps, following torque sequence for each step. Start first step at 20 lb. ft. (27 N·m), second step at 50 lb. ft. (68 N·m), and finish with a final torque of 80 lb. ft. (109 N·m).



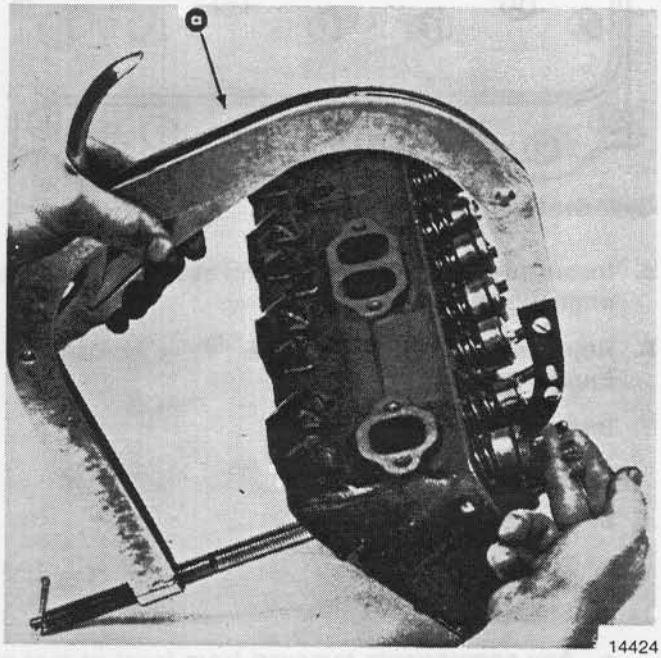
Cylinder Head Torque Sequence

5. Install push rods and rocker arm assemblies in their original positions.
6. Adjust valves as outlined under "Valve Adjustment - Engine Stopped."
7. Install as outlined:
   a. Intake manifold
   b. Rocker arm covers
   c. Exhaust manifolds
   d. Spark plugs
   e. Any components removed from front or rear of cylinder heads.
8. Start engine, set timing, set idle speed, and check for leaks.

Cylinder Head and Valve Conditioning

Disassembly

1. Using Tool J-8062 (a), compress valve spring and remove valve locks. Slowly release tool.

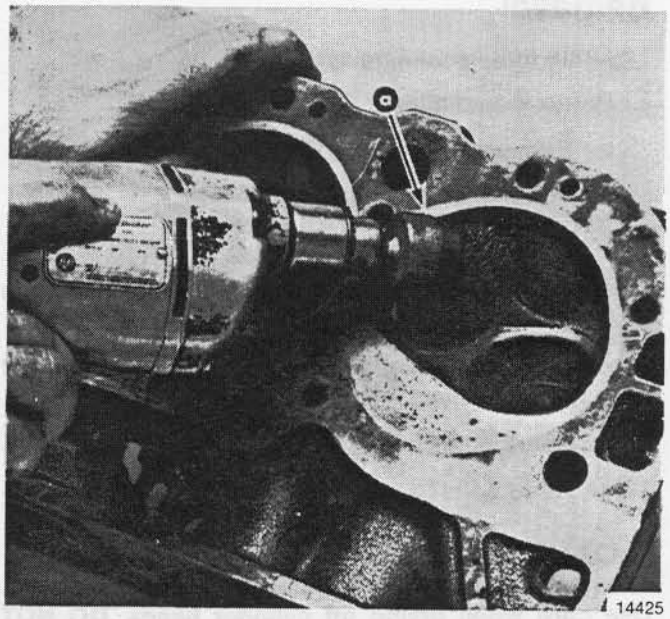


Typical

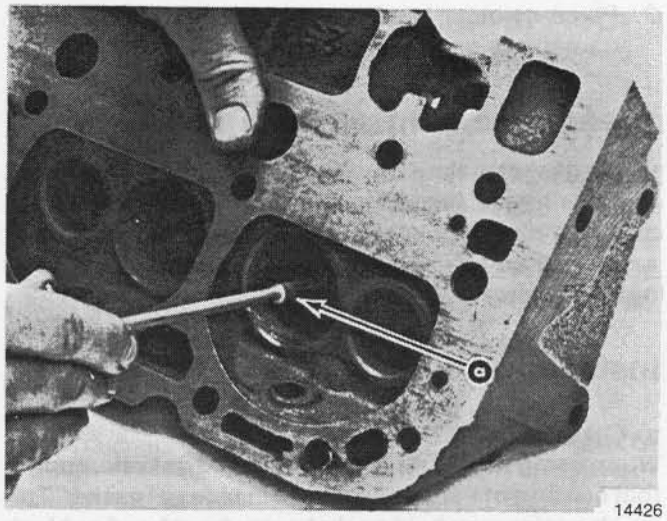
2. Remove all valve components.
3. Remove valves from cylinder head and place in a rack, in order, for reassembly in their original locations.

Cleaning

1. Clean push rods and rocker arm assemblies.
2. Clean carbon from valves using a wire wheel.
3. Clean gasket material from cylinder head mating surface.
4. Clean all carbon from combustion chambers and valve ports using tool J-8089 (a).



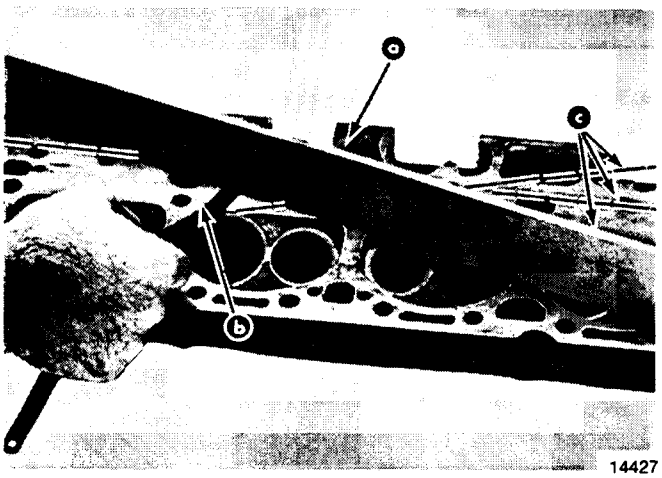
5. Thoroughly clean valve guides using tool J-8101 (a).



Cleaning Valve Guides - Typical

Inspection

1. Inspect cylinder heads for cracks in exhaust ports, water jackets, and combustion chambers (especially around spark plug holes and valve seats). Replace heads if any cracks are found.
2. Inspect cylinder head gasket surface for burrs, nicks, erosion or other damage. Also, check flatness of cylinder head gasket surface, using a machinists straight edge and feeler gauges as shown. Refer to "Specifications".



a - Straight Edge
b - Feeler Gauge
c - Take Measurements Diagonally Across Head (Both Ways) and Straight Down Center Head

Checking Gasket Surface of Cylinder Head for Flatness - Typical

IMPORTANT: Cylinder head to block gasket surface should be resurfaced if out-of-flat more than specified. When resurfacing, cylinder head to intake manifold gasket surface also must be milled to provide proper alignment between intake manifold and head.

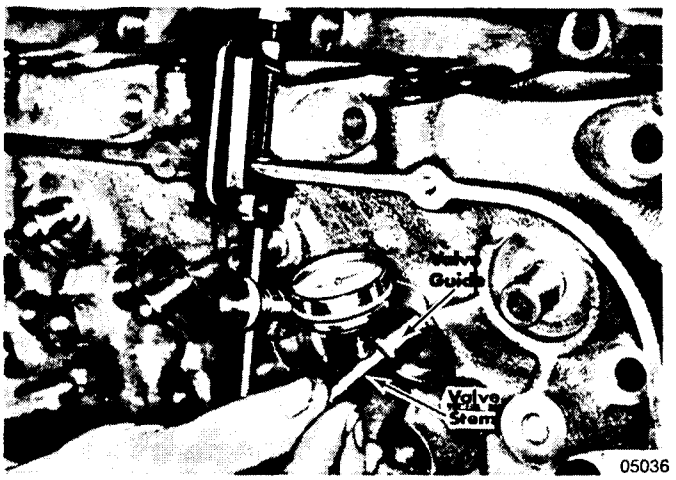
3. Inspect valves for burned heads, cracked faces or damaged stems.
4. Inspect rocker arm studs for wear or damage. Inspect push rod guides for wear or damage.

IMPORTANT: Rocker arm studs are threaded into the cylinder head. Coat threads on cylinder head end of rocker arm studs with Perfect Seal before assembling to cylinder head.

Push rod guides are attached to cylinder head by rocker arm studs. Replace if worn and torque rocker arm studs to 50 lb. ft. (68 N·m).

IMPORTANT: Excessive valve stem to bore clearance will cause excessive oil consumption and possible valve breakage. Insufficient clearance will result in noisy and sticky valves.

5. Measure valve stem clearance as follows:
   a. Attach a dial indicator to cylinder head, positioning it against the valve stem and close to the valve guide.
   b. Holding valve head off seat about 1/16 in. (2mm), move valve stem back and forth in direction shown. Compare stem clearance with specifications.
   c. If clearance exceeds specifications, it will be necessary to ream valve guides for oversized valves, as outlined under "Valve Guide Bore Repair."



Measuring Valve Stem Clearance

Valve Guide Bore Repair

If .015 in. oversize valves are required ream valve guide bores for oversize valves, as follows:

1. Measure valve stem diameter of old valve being replaced and select proper size Valve Guide Reamer from chart below.

Standard Valve Stem Diameter	Reamer Required for .015 in. Oversize Valve
.372 in.	J-7049

2. Ream valve guide bores.
3. Remove the sharp corner created by reamer at top of valve guide.

Valve Springs - Checking tension

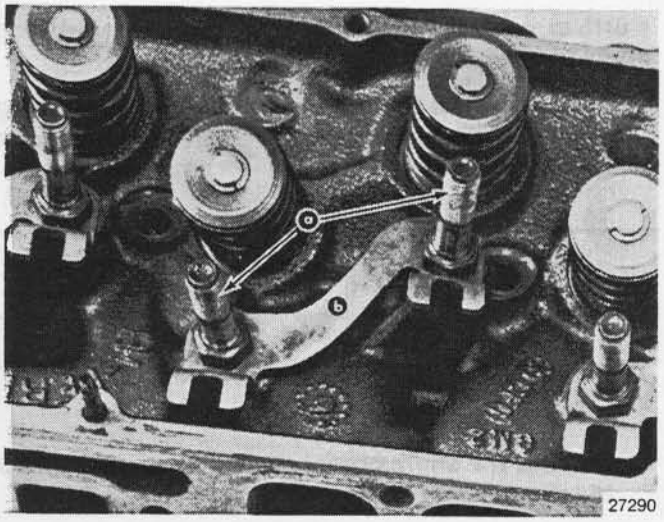
Using tester J-8056, as shown, check valve spring tension with dampers removed. Refer to "Specifications."

IMPORTANT: Springs should be replaced if not within 10 lb. (44 N) of specified tension.

Checking Valve Spring Tension

Rocker Arm Stud Replacement

Remove studs if worn, damaged or if replacing push rod guides. When installing, torque studs to 50 lb. ft. (68 N·m).



a - Rocker Arm Studs
b - Push Rod Guide

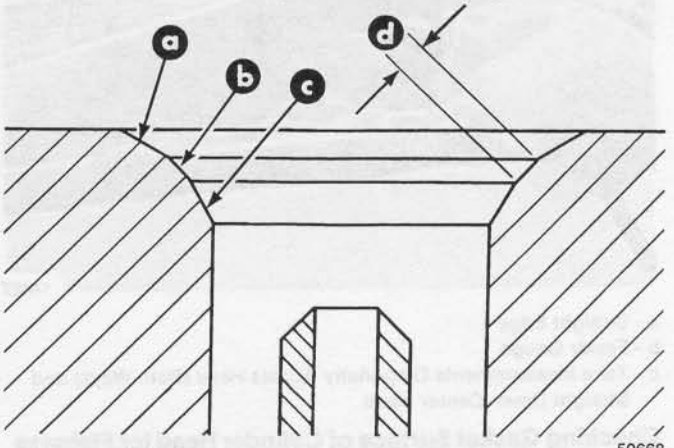
Valve Seat Repair

Valve seat reconditioning is very important, since seating of valves must be perfect for engine to deliver maximum power and performance.

Another important factor is valve head cooling. Good contact between each valve and its seat in head is important to insure that heat in valve head will be properly dispersed.

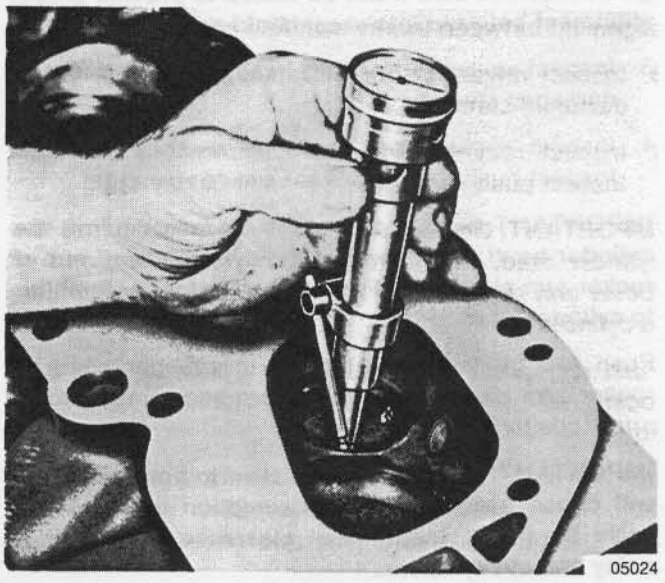
Several different types of equipment are available for reseating valve seats. Equipment manufacturer's recommendations should be followed carefully to attain proper results.

Regardless of type of equipment, however, it is essential that valve guide bores be free from carbon or dirt to insure proper centering of pilot in valve guide.



a - Top Angle (30°)
b - Seat Angle (46°)
c - Bottom Angle (60°)
d - Seat Width: Intake .060 - .090 in. (1.52 - 2.29mm)
Exhaust .060 - .090 in. (1.52 - 2.29mm)

Typical "3 Angle" Valve Seat

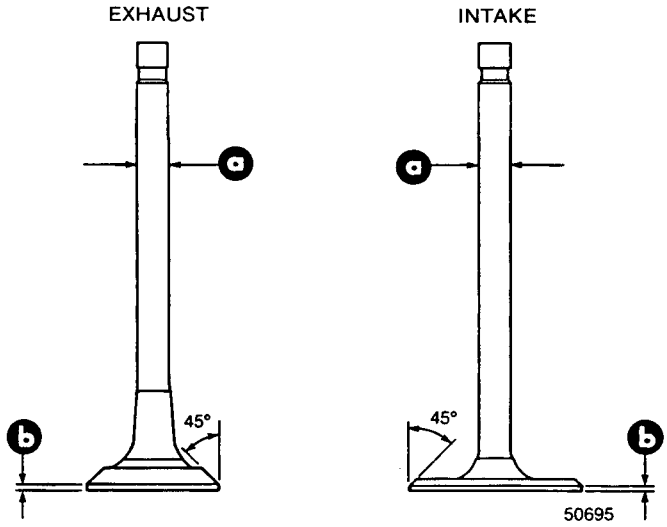


Measuring Valve Seat Out-of-Round

Valve Grinding

Valves that are pitted must be refaced to the proper angle. Valve stems which show excessive wear, or valves that are warped excessively must be replaced. When a valve head which is warped excessively is refaced, a knife edge will be ground on part or all of the valve head due to the amount of metal that must be removed to completely reface. Knife edges lead to breakage, burning, or pre-ignition due to heat localizing on this knife edge. If the edge of the valve head is less than 1/32 in. (.8mm) after grinding, replace the valve.

Several different types of equipment are available for refacing valves. The recommendation of the manufacturer of the equipment being used should be carefully followed to attain proper results.

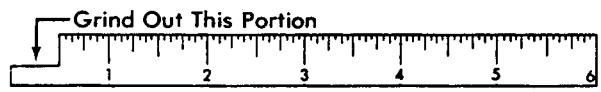


Exhaust
a - .372 in. (9.45mm)
b - 1/32 (.031) in. (.79mm) min.

Intake
a - .372 in. (9.45mm)
b - 1/32 (.031) in. (.79mm) min.

Reassembly

1. Lubricate valve guides and valve stems with engine oil.
2. Install each valve in the port from which it was removed or to which it was fitted.
3. Install valve rotators, shims, springs, seals, and caps as shown under "Valve Spring and Seal Assembly" for each particular engine.
4. Using Tool J-8062, compress valve spring and install valve locks (grease may be used to hold locks in place).
5. Slowly release tool, making sure valve locks seat properly in grooves of valve stem.
6. Check installed height of valve springs using a narrow, thin scale. Measure from spring seat to top of valve spring, as shown. If measurement exceeds specified height, install a valve spring shim and recheck. DO NOT shim valve springs to give an installed height less than the minimum specified.



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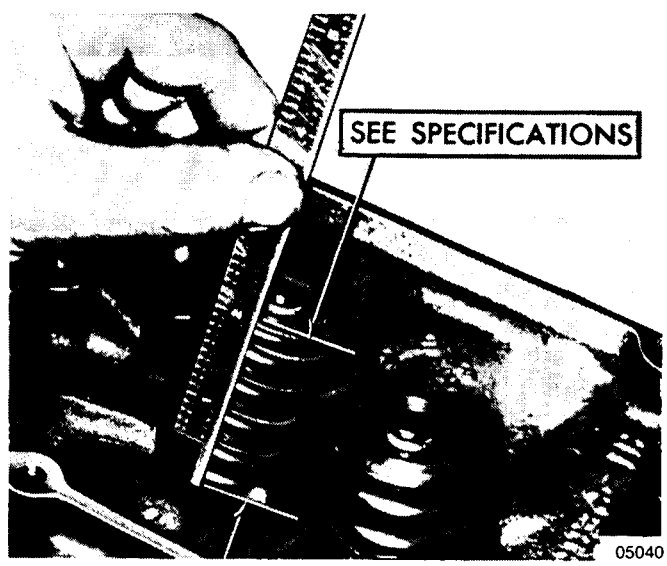
Cutaway Scale



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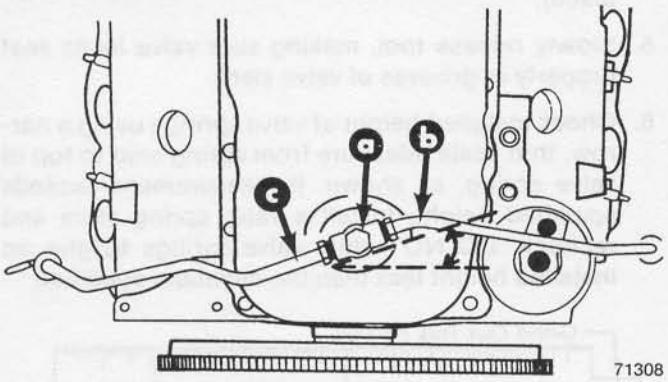
Measuring Valve Spring Installed Height

Oil Pan

Removal

1. Drain crankcase oil.
2. Remove dipstick and tube, or tubes, if equipped with two. Note shape of port and starboard tubes as shown following to aid in reassembly.

IMPORTANT: On Generation V engines DO NOT move or disturb the orientation of fitting on bottom of pan or incorrect oil level readings may be obtained.



71308

a - Factory Positioned Fitting for Tubes (Do Not Move)
b - Port Tube
c - Starboard Tube

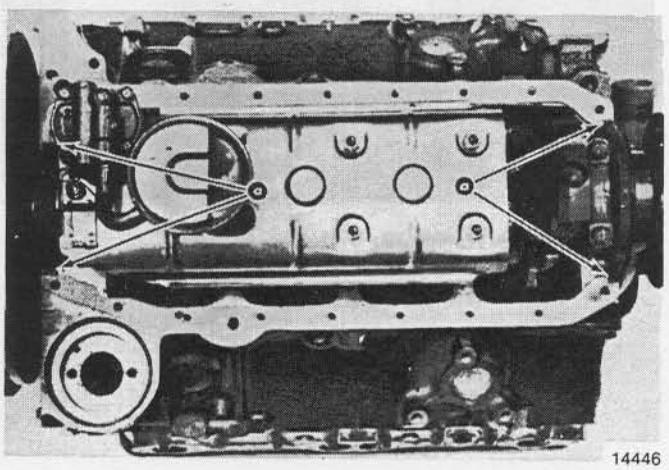
Generation V MIE Engine Oil Pan (If So Equipped)

3. Remove oil pan.

Installation

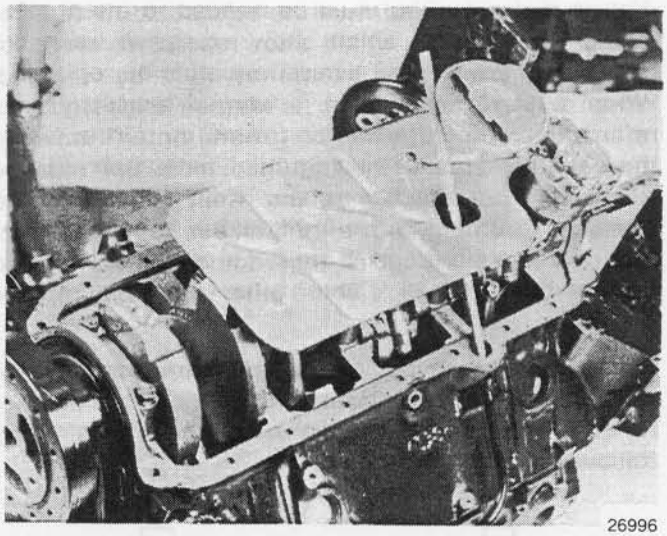
1. Clean sealing surfaces of engine block and oil pan.
2. Apply a small amount of RTV Sealer to joints of rear seal retainer and joints of front cover.

IMPORTANT: RTV Sealer sets up in about 15 minutes. Be sure to complete assembly promptly.


14446

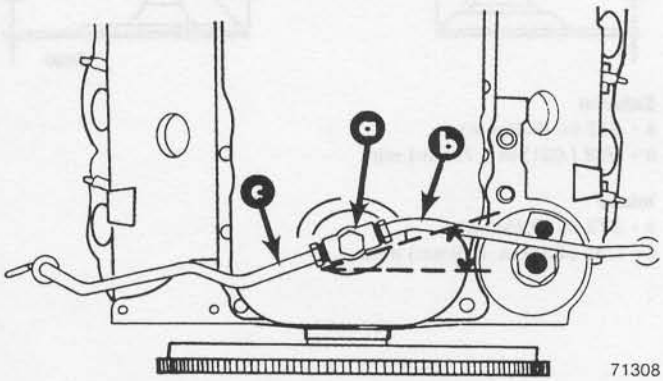
a - Apply RTV to Mating Joints

3. Install oil pan gasket in position as shown.


26996

4. Install oil pan. Starting from the center and working outward in each direction, tighten screws to 100 lb. in. (11 N·m). Tighten nuts to 200 lb. in. (22 N·m).
5. Install dipstick tube(s) and dipstick. Be certain, if equipped with two tubes that they are fitted where they were removed, and positioned as shown following.

IMPORTANT: On Generation V engines DO NOT move or disturb the orientation of fitting on bottom of pan or incorrect oil level readings may be obtained.

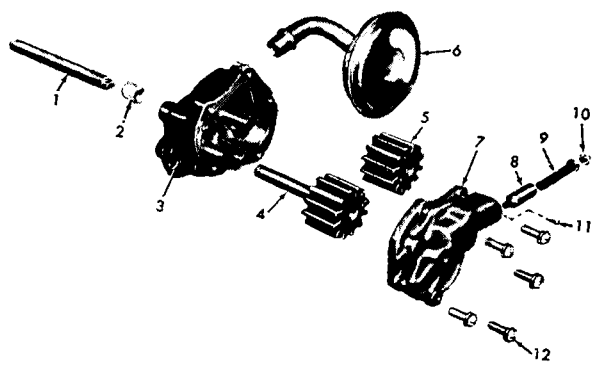


71308

a - Factory Positioned Fitting for Tubes (Do Not Move)
b - Port Tube
c - Starboard Tube

Generation V MIE Engine Oil Pan (If So Equipped)

Oil Pump



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1 - Shaft Extension
2 - Shaft Coupling
3 - Pump Body
4 - Drive Gear and Shaft
5 - Idler Gear
6 - Pickup Screen and Pipe
7 - Pump Cover
8 - Pressure Regulator Valve
9 - Pressure Regulator Spring
10 - Washer
11 - Retaining Pin
12 - Screws

Oil Pump Assembly

The oil pump consists of 2 gears and a pressure regulator valve enclosed in a 2-piece housing. Oil pump is driven by distributor shaft which is driven by a helical gear on camshaft.

NOTE: Oil pick-up tube is welded to pump body and is not serviceable.

Removal

1. Remove oil pan, as outlined.
2. Remove baffle, if so equipped.
3. Remove oil pump.

Disassembly

1. Remove pump cover.

IMPORTANT: Mark gear teeth for reassembly with same teeth indexing.

2. Remove idler gear and drive gear from pump body.
3. Remove retaining pin, spring, and pressure regulator valve from pump cover.

IMPORTANT: Do not disturb pickup screen on pipe. This is serviced as an assembly.

Cleaning and Inspection

1. Wash all parts in cleaning solvent and dry with compressed air.
2. Inspect pump body and cover for cracks or excessive wear.
3. Inspect pump gears for damage or excessive wear.
4. Check for loose drive gear shaft in pump body.
5. Inspect inside of pump cover for wear that would permit oil to leak past ends of gears.
6. Inspect pickup screen and pipe assembly for damage to screen or pipe.
7. Check pressure regulator valve for fit.

IMPORTANT: Pump gears and body are not serviced separately. If pump gears or body are damaged or worn, replacement of entire oil pump assembly is necessary.

Reassembly

IMPORTANT: Oil internal parts liberally before installation.

1. Install pressure regulator valve and related parts.
2. Install drive gear in pump body.
3. Install idler gear in pump body with smooth side of gear toward pump cover opening. Align marks made in disassembly.
4. Fill gear cavity with engine oil.
5. Install pump cover and torque attaching screws to 80 lb. in. (9 N·m).
6. Turn drive shaft by hand to check for smooth operation.

Installation

1. Install pump, with extension shaft, to rear main bearing, aligning extension shaft with distributor drive shaft. Tighten oil pump bolt to 65 lb. ft. (88 N·m).
2. Install baffle, if so equipped. Torque nuts to 25 lb. ft. (34 N·m).
3. Install oil pan, as outlined.

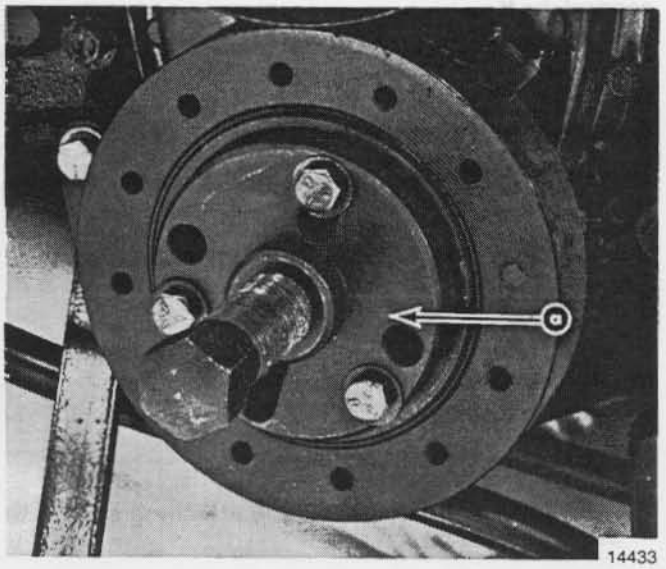
Crankshaft Damper

Removal

1. Remove drive belts.
2. Remove drive pulley, then remove damper retaining bolt.

IMPORTANT: Do not use a universal claw type puller to remove crankshaft damper (in next step) as outside ring of damper is bonded in rubber to the hub and use of claw type puller may break the bond.

3. Remove damper with Tool J-23523-E (a).



a - Damper Puller

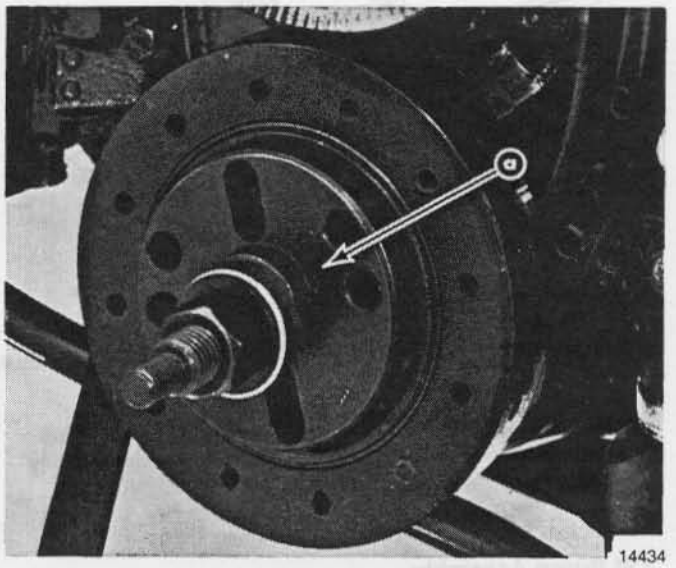
Installation

IMPORTANT: The inertia weight section of crankshaft damper is assembled to the hub with a rubber type material. The installation procedure (with proper tool) must be followed or movement of the inertia weight on the hub will destroy the tuning of the damper.

1. Replace key in crankshaft if it is damaged.
2. Coat seal surface of damper with engine oil.
3. Pull damper onto crankshaft, using Tool J-23523-E as follows:
   a. Install appropriate end of threaded rod into crankshaft.

IMPORTANT: Be sure to install threaded rod in crankshaft at least 1/2 in. (13mm) to prevent damage to threads.

   b. Install plate, thrust bearing, washer and nut on rod.



a - Tool J-23523-E

   c. Pull damper onto crankshaft by turning nut until it bottoms-out.
   d. Remove tool from crankshaft.
   e. To prevent oil leakage, apply RTV sealant to damper keyway.
   f. Install damper bolt. Torque to 85 lb. ft. (115 N·m).
3. Install drive pulley(s). Torque bolts to 35 lb. ft. (48 N·m).
4. Install and adjust drive belts.

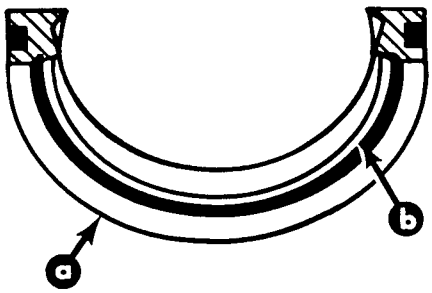
Crankcase Front Cover/Oil Seal

Oil Seal Replacement (Without Removing Front Cover)

Removal

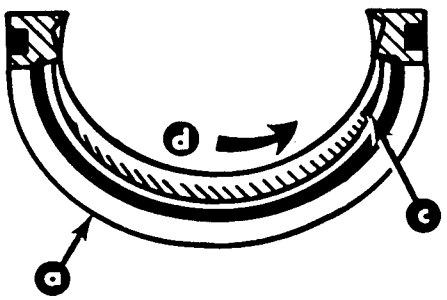
1. Remove crankshaft damper.
2. Pry seal out of cover from the front with a large screwdriver, being careful not to distort front cover or damage crankshaft seal surface.

IMPORTANT: Correct rotation oil seal must be used to prevent oil leak.

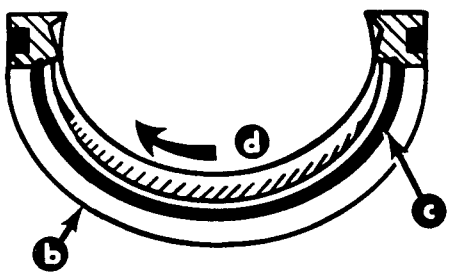


a - Can Be Used On Any Rotation Engine
b - Seal Lip Toward Inside of Engine

Front Seal WITHOUT Helical Grooves



a - MCM and MIE (L.H.) Rotation Engines



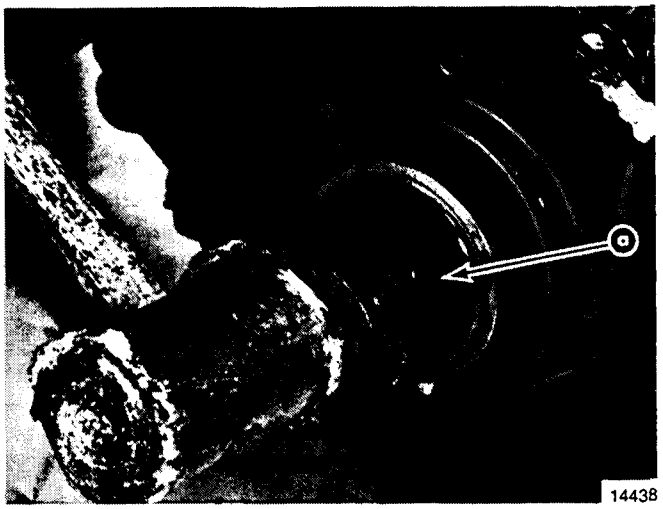
50708

b - MIE (R.H.) Rotation Engines
c - Seal Lip Toward Inside of Engine
d - Rotation of Crankshaft as Viewed from Flywheel End Looking Forward

Front Seals WITH Helical Grooves

Installation

1. Install new seal with open end of seal inward, using Tool J-22102. Drive seal in until it just bottoms out. Do not use excessive force.



a - Tool J-22102

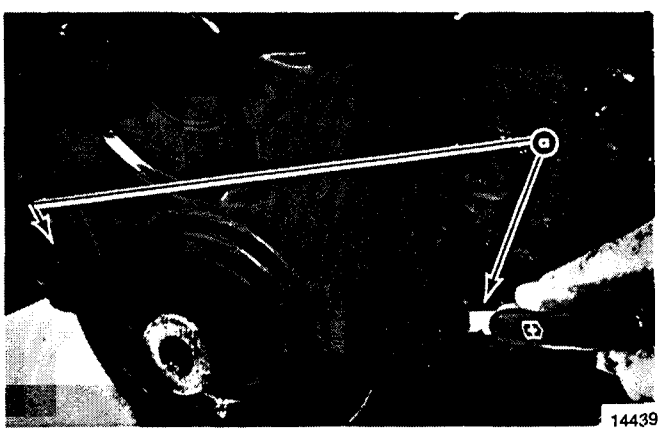
2. Reinstall crankshaft damper, as outlined.

Oil Seal Replacement (Cover Removed)

Removal

NOTE: The following instructions outline removal of front cover without removing oil pan. If oil pan must be removed for other engine service, remove oil pan and disregard Step 3, 4 and 5, following.

1. Remove crankshaft damper.
2. Remove water circulating pump.
3. Remove 2 oil pan to front cover attaching screws.
4. Remove crankcase front cover attaching screws and timing pointer, then pull cover slightly forward (only enough to permit cutting of oil pan front seal).
5. Using a sharp knife, cut oil pan front cover seal flush with cylinder block on both sides of cover.



a - Cut Off Seal on Both Sides

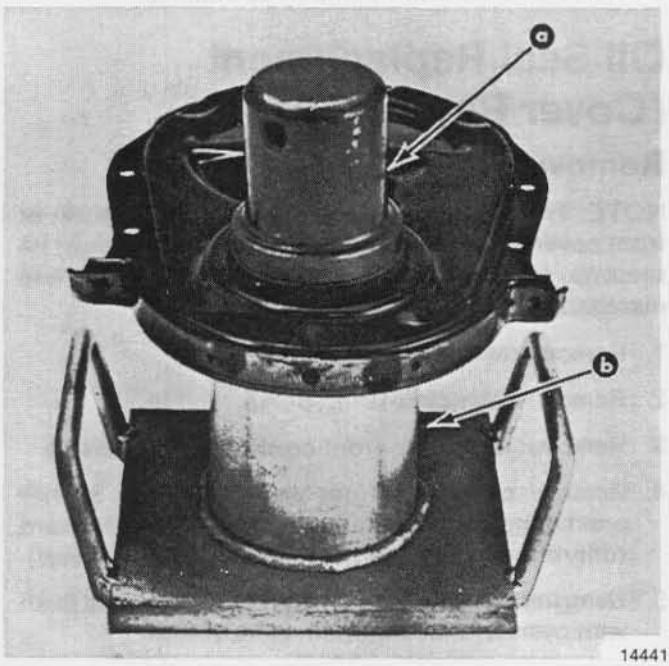
6. Remove front cover and attached portion of oil pan front seal. Remove and discard oil pan front seal and front cover gasket.
7. If damaged, drive oil seal out of front cover (from the rear) with a punch.

Installation

IMPORTANT: Correct rotation oil seal must be used to prevent oil leak.

NOTE: The following instructions outline installation of front cover without oil pan removed. If oil pan has been removed for other engine service, disregard Step 3, 4, 6, 8 and 10 and install oil pan after front cover has been installed.

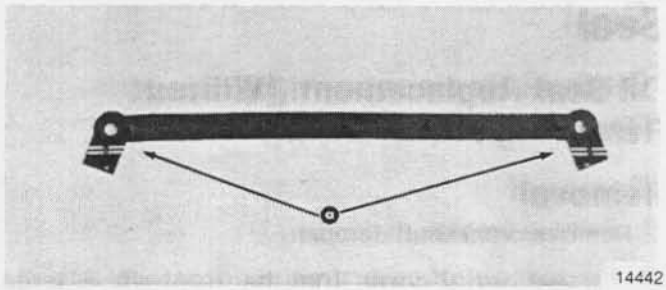
1. Clean front cover in solvent and dry with compressed air. Clean old gasket material and sealer from mating surfaces on cover and cylinder block. Check gasket surface on front cover for distortion.
2. Install oil seal in cover with lip of seal toward inside of engine, using Tool J-22102. Support cover around seal area with appropriate tool as shown.



14441

a - Tool J-22102
b - Support (To Prevent Distorting Cover)

3. Coat both sides of front cover gasket with Perfect Seal and place in position on engine. Be sure to position gasket over dowel pins.
4. Cut tabs from the new oil pan front seal.



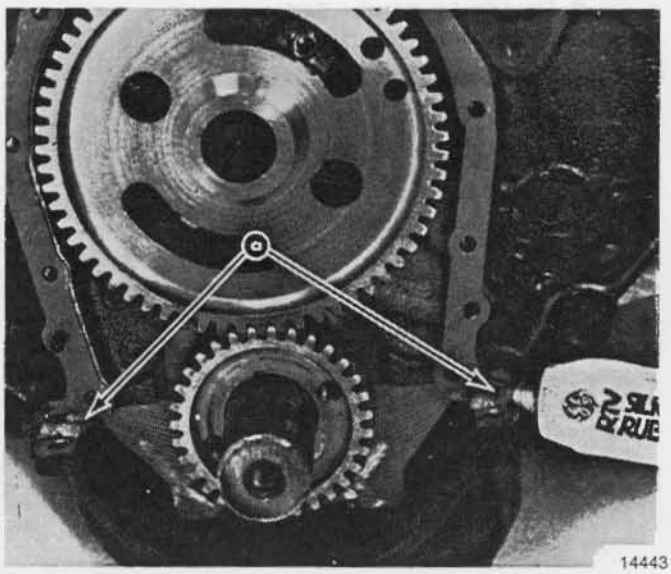
14442

a - Cut This Portion From New Seal

5. Apply a 1/8 in. (3mm) wide bead of RTV Sealer across entire length of seal surface on front cover. Install seal to front cover, pressing tips into holes provided in cover. After seal is installed, place a 1/8 in. wide bead of RTV Sealer across entire length of outer seal surface.

IMPORTANT: Use of RTV Sealer on outer surface of seal is essential on inboard and V-drive engines which have aluminum oil pans.

6. Apply a 1/8 in. (3mm) bead of RTV Sealer to the joints formed where oil pan mates against cylinder block.



14443

a - 1/8" (3mm) Wide Bead of RTV Sealer

RTV Sealer Applied to Oil Pan to Cylinder Block Joints

7. Position crankcase front cover over crankshaft.
8. Press front cover downward against oil pan until holes in cover align with dowel pins on block and push cover over pins. Install and partially tighten the 2 oil pans to front cover attaching screws to retain cover.
9. Install front cover attaching screws and timing pointer (if removable). Torque screws to specifications.
10. Torque 2 oil pans to front cover attaching screws (installed in Step 8) to specifications.
11. Install crankshaft damper.
12. Install water circulating pump.
13. Start engine and check for water and oil leaks.

Flywheel

Removal

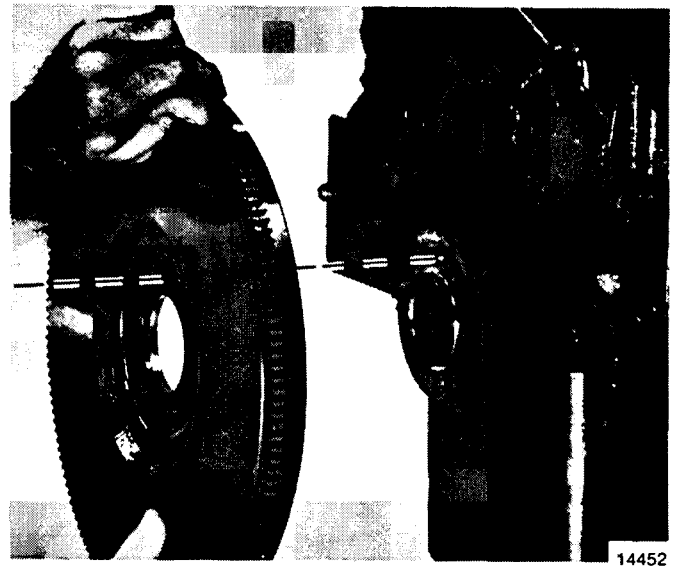
1. Remove engine from boat.
2. Remove transmission, if so equipped.
3. Remove flywheel housing and related parts.
4. Remove drive plate attaching screws and washers and remove drive plate, then remove flywheel attaching screws and washers and remove flywheel.

Inspection

1. Inspect drive plate for wear.
2. Check flywheel ring gear for worn or missing teeth.

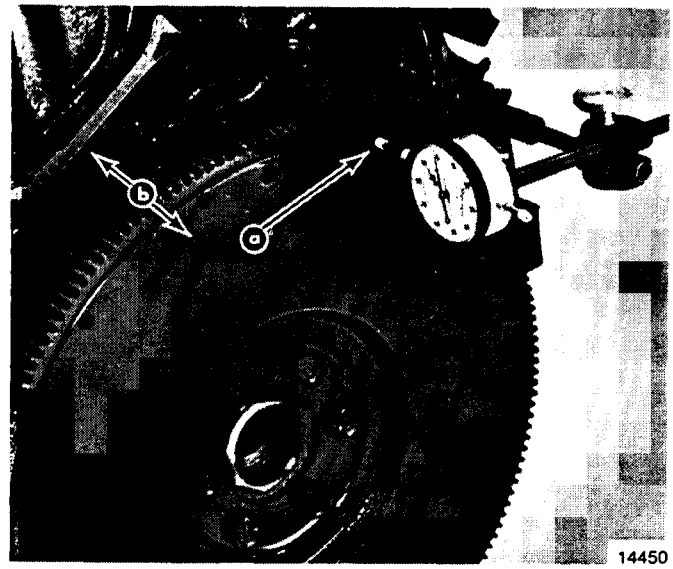
Installation

1. Clean mating surfaces of flywheel and crankshaft.
2. Align dowel hole in flywheel with dowel or dowel hole in crankshaft flange and place flywheel in position on flange. Torque bolts to 65 lb. ft. (88 N·m).


14452

3. Check flywheel runout by mounting dial indicator on machined surface of flywheel.

   Runout should not exceed .008 in. (.203mm). If excessive, remove flywheel and check for burrs or replace flywheel.



14450

a - .008 in. (.203mm) Max. Runout
b - Hold Flywheel and Crankshaft Forward As Far As It Will Go When Taking Reading

4. Install drive plate and torque to 35 lb. ft. (48 N·m).
5. Install flywheel housing and related parts, if so equipped. Torque flywheel housing screws to 30 lb. ft. (41 N·m).
6. Torque flywheel housing cover screws to 80 lb. in. (9 N·m).
7. Install transmission, if so equipped.
8. Install engine in boat.

Rear Main Oil Seal

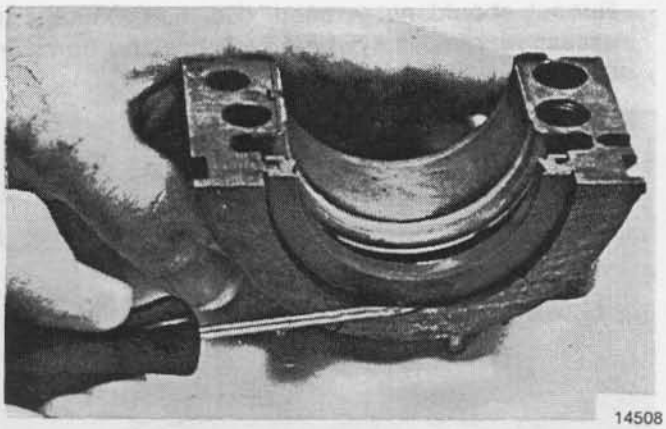
Two-Piece Oil Seal (Early Style)

REPLACEMENT

Rear main bearing oil seal can be replaced (both halves) without removing crankshaft.

IMPORTANT: Always replace upper and lower seal as a unit. Install with lip facing toward inside of engine.

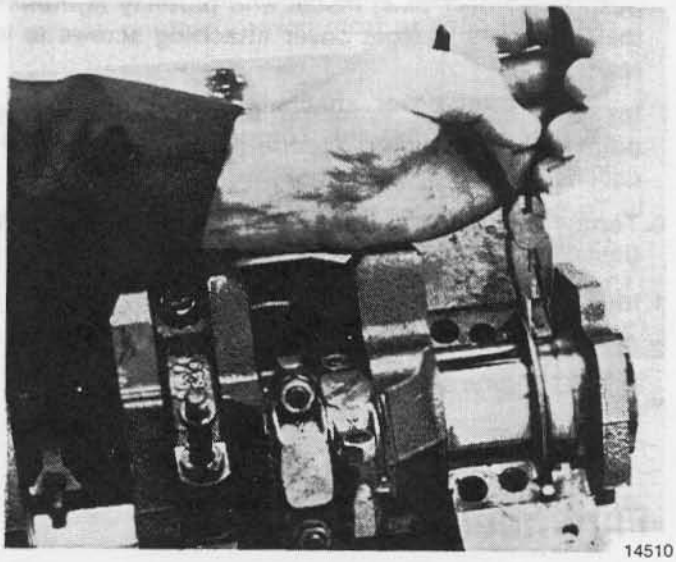
1. Remove oil pan and oil pump.
2. Remove rear main bearing cap.
3. Remove lower half of oil seal from the bearing cap by prying from the bottom with a small screwdriver. Be careful not to damage seal seating surface.



14508

Removing Lower Half of Oil Seal

4. Using a hammer and a soft metal pin punch, tap upper half of oil seal on one end until it protrudes far enough on the other end to remove it with a pliers.



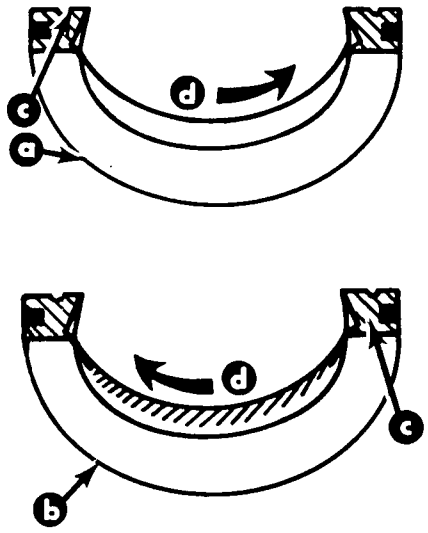
14510

Removing Upper Half of Oil Seal

5. Clean, rear main bearing cap, cylinder block and crankshaft with solvent and blow dry with compressed air. Be sure all of the old sealer is removed from bearing cap and cylinder block mating surfaces.

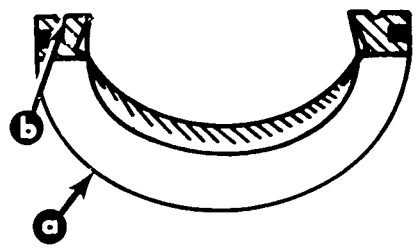
INSTALLATION

IMPORTANT: Correct rotation oil seal must be used to prevent oil leak.



a - MCM and MIE (L.H.) Rotation Engines
b - MIE (R.H.) Rotation Engines
c - Seal Lip Toward Inside of Engine
d - Rotation of Crankshaft as Viewed From Flywheel End Looking Forward

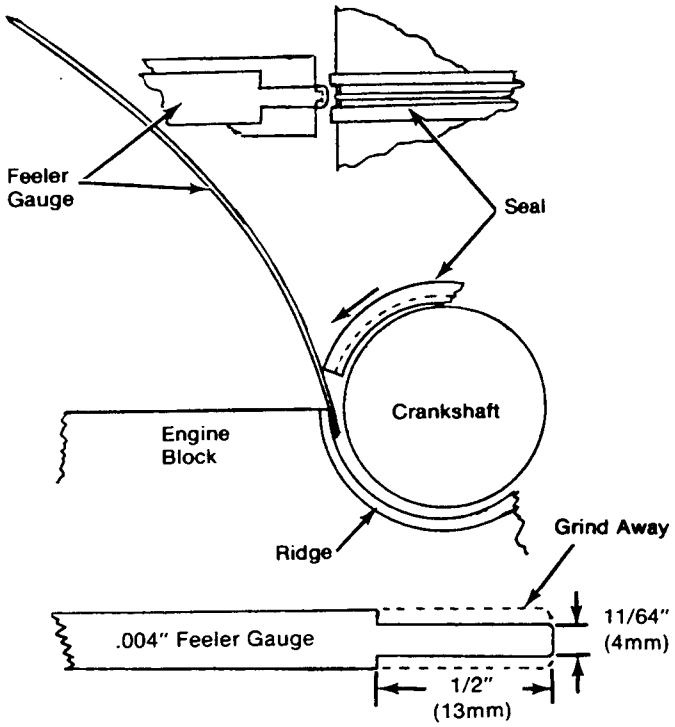
Rear Seals WITH Helical Grooves



a - Can Be Used On Any Rotation Engine
b - Seal Lip Toward Inside of Engine

Rear Seal WITHOUT Helical Grooves

Extreme care must be exercised when installing seal to prevent damage to sealing bead, located in the channel on outside diameter of the seal. To protect this bead, installation tool must be used. Construct tool using .004 in. (.1mm) shim stock, if tool is not supplied with seal.



Installing Rear Main Seal - Cylinder Block Inverted

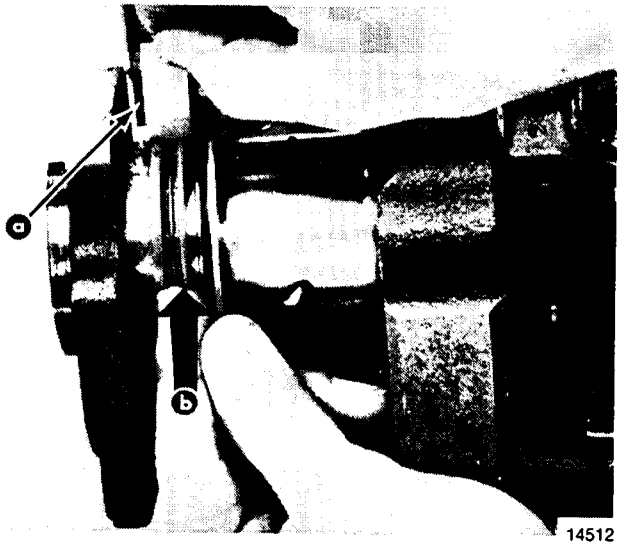
1. Coat lips and sealing bead on new rear oil seal with engine oil. Keep oil off of seal parting surfaces.

IMPORTANT: Be sure to install oil seal with lip facing toward inside of engine.

2. Install upper half of oil seal:
   a. Position tip of installation tool between crankshaft and seal seating surface in cylinder block.
   b. Position upper half of seal between crankshaft and tip of installation tool so that seal bead contacts tip of tool.
   c. Roll upper half of seal around crankshaft using installation tool as a "shoe-horn" to protect seal bead from sharp corner of seal seating surface.

IMPORTANT: Installation tool must remain in position until seal is properly positioned with both ends flush with block.

d. After both ends of seal half are flush with block, remove installation tool.



a - Installation Tool
b - Roll Seal Into Place In This Direction

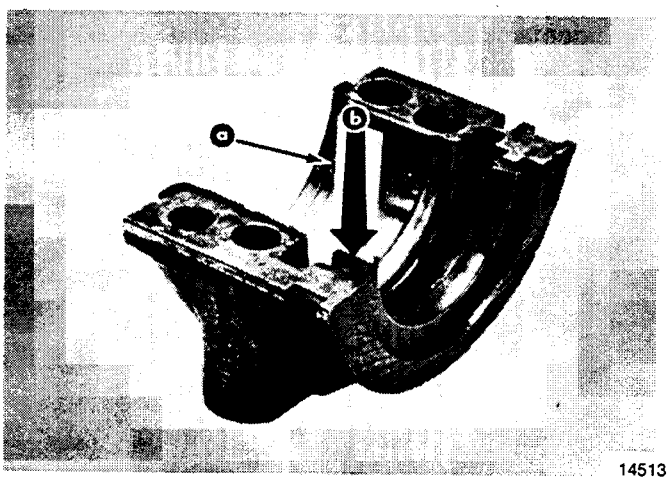
Installing Upper Half of Oil Seal

3. Install lower half of oil seal:

   a. Position oil seal half in rear main bearing cap so that one end is slightly below mating surface and seal lip is facing toward bearing. Do not allow sealing bead on other end of seal half to contact seal seating surface.

   b. Insert installation tool in between sealing bead and seal seating surface, then, using tool as a "shoe-horn" to protect sealing bead from sharp corner of seal seating surface, roll seal into place. Seal is properly positioned when both ends are flush with cap.

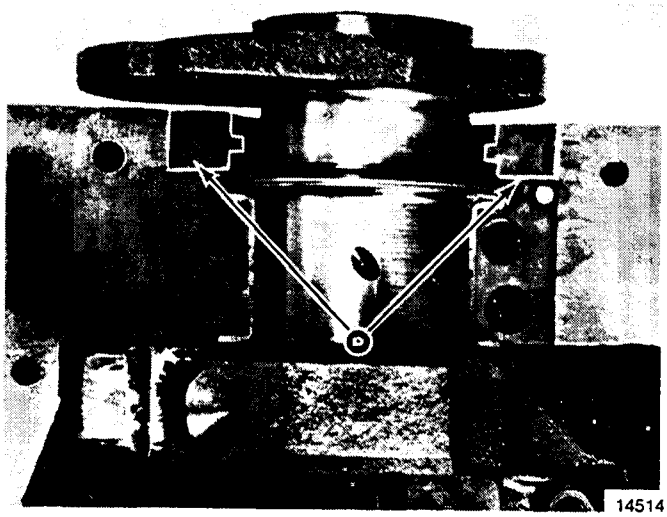
   c. Remove installation tool.



a - Installation Tool
b - Roll Seal Half Into Position in This Direction

Installing Lower Half of Oil Seal

4. Make sure that bearing cap and cylinder block mating surfaces and oil seal parting surfaces are clean and free of oil, then apply Perfect Seal to block at locations shown. Do not get sealer on seal parting surfaces or on surfaces adjacent to main bearing inserts.



a - Apply Perfect Seal to Outlined Area Only

Applying Sealer to Block

5. Install rear main bearing cap and torque attaching bolts to 10-12 ft. lbs. (13-16 N·m). Tap crankshaft first rearward and then forward with a lead hammer to line up rear main bearing thrust surfaces. With crankshaft in forward position, torque rear main bearing cap attaching bolts evenly (alternating from side to side) to 110 lb. ft. (149 N·m).

6. Install oil pump and oil pan as outlined.

One-Piece (New Style)

The new style rear crankshaft oil seal can be replaced without removing the oil pan or rear main bearing cap from engine.

REMOVAL

1. Remove flywheel.
2. Pry old oil seal from cylinder block assembly. Take care that crankshaft seal surface is not damaged by tool.

CLEANING and INSPECTION

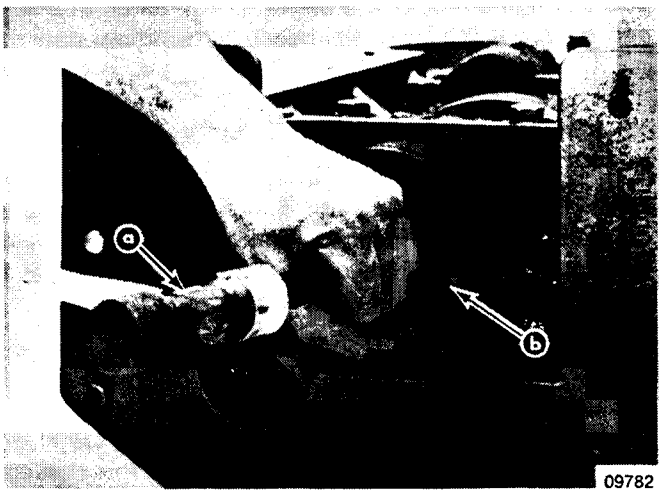
1. Clean oil seal cavity in cylinder block.
2. Inspect area on crankshaft (where oil seal rides) for damage. If necessary, clean up crankshaft surface with No. 320 grit polishing cloth and engine oil. Replace crankshaft if damage is too great.
3. DO NOT reinstall used seals.

INSTALLATION

IMPORTANT: Rear main bearing cap must be properly installed before installation of oil seal.

NOTE: It is not necessary to use sealer on oil seal or housing.

1. Lubricate oil seal lip and crank surface with engine oil, or suitable grease.
2. Drive seal (with lip facing inward) into cylinder block cavity until it bottoms-out. Use a suitable tool. Take care not to cock seal during installation.



a - Mallet
b - Suitable Tool

Installing Typical One-Piece Oil Seal

Main Bearings

General

ON ALL ENGINES, main bearings are precision insert type and do not utilize shim for adjustment. If clearances are excessive, both upper and lower halves of new bearing, and possibly crankshaft service, will be required. Bearings are available in standard size and undersize.

ON GENERATION V ENGINES (engines with cast aluminum valve covers and lack of fuel pump mounting pad on engine block), the internal production tolerances on crankshafts (main bearing journals and rod journals) are controlled so accurately that production main bearings and rod bearings are one size only. Engines are not selectively fitted in production with undersize inserts.

IMPORTANT: If during service a Generation V engine crankshaft is found to have an undersize journal and a new bearing is required, journal must be reconditioned to accept a .010 in. or a .020 in. undersize bearing.

ON ENGINES OTHER THAN GENERATION V, selective fitting of both rod and main bearing inserts is necessary in production to obtain close tolerances. Consequently, one half of a standard insert may have one half of a .001 in. (0.025mm) undersize insert which will decrease clearance .0005 in. (0.0127mm) from using a full standard bearing.

When a production crankshaft cannot be precision fitted by this method, it then is ground .009 in. (.229mm) undersize on main journals only. A .009 in. undersize bearing and .010 in. undersize bearing may be used for precision fitting in the same manner as previously described. Any engine fitted with a .009 in. undersize crankshaft will be identified by the following markings:

- ".009" will be stamped on crankshaft counterweight forward of center main journal.
- A figure "9" will be stamped on block at left front oil pan rail.
- A crankshaft with an undersize journal will be painted with light green on each side of the affected journal.

IMPORTANT: If crankshaft has an undersize journal and a new bearing is required, journal must be reconditioned to accept a .010 in. or a .020 in. undersize bearingas .009 in. undersize bearings are not available for service.

Inspection

In general (except No. 1 bearing), lower half of bearing shows a greater wear and most distress from fatigue. After inspection, if lower half is suitable for use, it can be assumed that the upper half also is satisfactory. If lower half is worn or damaged, both upper and lower halves should be replaced. Never replace one half without replacing the other.

Checking Clearance

To obtain accurate measurements while using "Plastigage," or its equivalent, engine must be out of the boat and upside down so crankshaft will rest on the upper bearings and total clearance can be measured between lower bearing and journal.

IMPORTANT: To assure proper seating of crankshaft, all bearing cap bolts should be at their specified torque. In addition, surface of crankshaft journal and bearing should be wiped clean of oil before checking fit of bearings. Remove oil seal from rear main bearing cap prior to checking clearance.

1. With oil pan, baffle (some engines) and oil pump removed (starting with rear main bearing), remove bearing cap and wipe oil from journal and bearing cap.
2. Place a piece of gauging plastic full width of bearing (parallel to crankshaft) on journal.

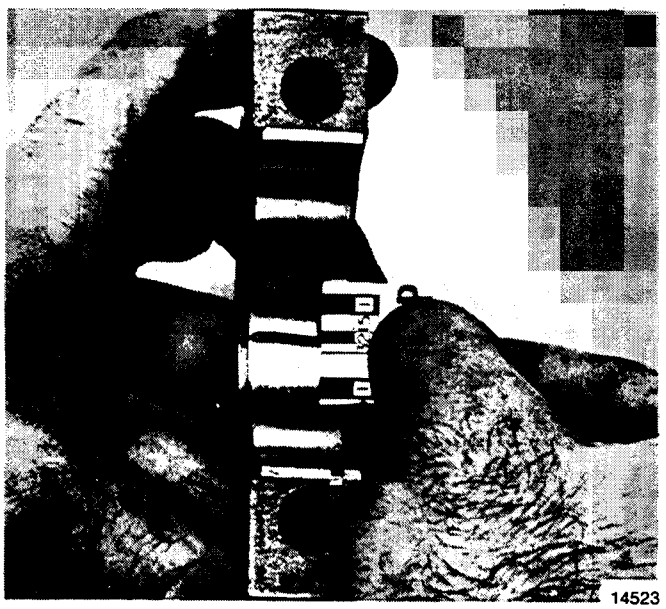
14521

Gauging Plastic on Journal

IMPORTANT: Do not rotate crankshaft while gauging plastic is between bearing and journal.

3. Install bearing cap and torque retaining bolts evenly to 110 lb. ft. (149 N·m).
4. Remove bearing cap. Flattened gauging plastic will be found adhering to either bearing shell or journal.

5. Without removing gauging plastic, measure its compressed width (at widest point) with graduations on gauging plastic envelope, as shown.


14523

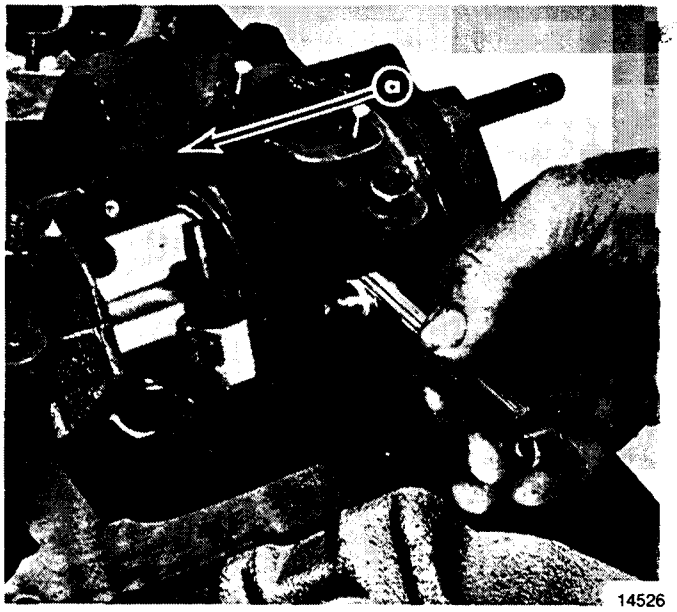
Measuring Gauging Plastic

IMPORTANT: Main bearing journals usually wear evenly and are not out-of-round. However, if a bearing is being fitted to an out-of-round journal (.001 in. [0.25mm] maximum), be sure to fit to maximum diameter of journal. If bearing is fitted to minimum diameter, and journal is out-of-round .001 in., interference between bearing and journal will result in rapid bearing failure. If flattened gauging plastic tapers toward middle or ends, there is a difference in clearance indicating taper, low spot or other irregularity of bearing or journal. Be sure to measure journal with a micrometer if flattened gauging plastic indicates more than .001 in. difference.

6. If bearing clearance is within specifications, bearing insert is satisfactory. If clearance is not within specifications, replace the insert. Always replace both upper and lower insert as a unit.

IMPORTANT: If a new bearing cap is being installed and clearance is less than .001 in., inspect for burrs or nicks.

7. A standard .001 in. or .002 in. undersize bearing may produce proper clearance. If not, regrind crankshaft journal for use with next undersize bearing.
8. Proceed to next bearing. After all bearings have been checked, rotate crankshaft to see that excessive drag does not exist.
9. Install front 4 main bearing caps and torque evenly to 110 lb. ft. (149 N·m).
10. Install rear main bearing cap and torque attaching bolts to 10-12 lb. ft. (13-16 N·m). Tap end of crankshaft first rearward and then forward with a hammer to align rear main bearing thrust surfaces. With crankshaft in forward position, torque rear main bearing attaching bolts evenly (alternating from side to side) to 110 lb. ft. (149 N·m).
11. Measure crankshaft end play with a feeler gauge by forcing crankshaft forward and measuring clearance between the front of the rear main bearing and the crankshaft. If clearance is excessive rear main bearing and/or crankshaft must be replaced.

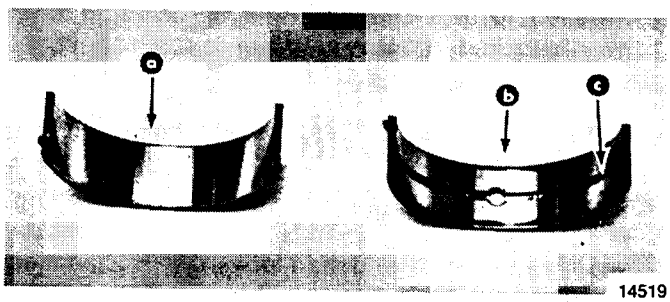

14526

a - Force Crankshaft Forward

12. Install a new rear main bearing oil seal in cylinder block and main bearing cap, as outlined.

Replacement

NOTE: Main bearings may be replaced with or without removing crankshaft.



a - Lower Bearing Insert (Install in Cap)
b - Upper Bearing Insert (Install in Block)
c - Oil Groove

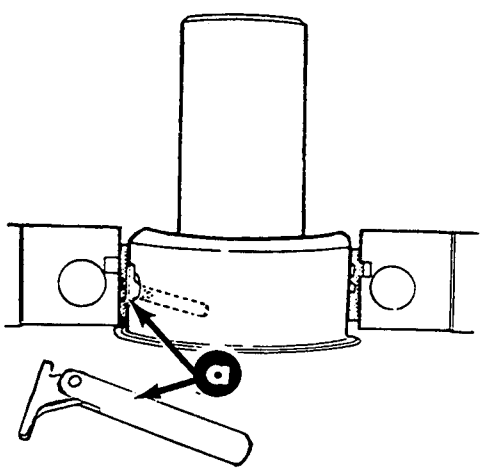
Main Bearing Inserts

WITH CRANKSHAFT REMOVED

1. Remove and inspect crankshaft.
2. Remove main bearings from cylinder block and main bearing caps.
3. Coat bearing surfaces of new, correct size, main bearings with oil and install in cylinder block and main bearing caps.
4. Install crankshaft.

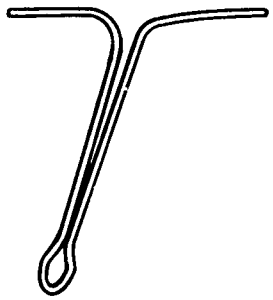
WITHOUT CRANKSHAFT REMOVED

1. With oil pan, baffle (some engines), oil pump and spark plugs removed, remove cap on main bearing requiring replacement and remove bearing from cap.
2. Replace main bearing upper half as follows:
   a. Install main bearing removing and installing Tool J-8080 in crankshaft journal oil hole, as shown.



a - Tool J-8080

NOTE: If Tool J-8080 is not available, bend a cotter pin, as shown.



   b. Rotate crankshaft clockwise (as viewed from front of engine). This will roll upper bearing out of block.
   c. Oil new selected size upper bearing and insert plain (unnotched) end between crankshaft and notched side of block. Rotate bearing into place and remove tool from oil hole in crankshaft journal.
3. Oil new lower bearing and install in bearing cap.
4. Install main bearing cap with arrows pointing toward front of engine.
5. Torque main bearing cap bolts to 110 lb. ft. (149 N·m).

Connecting Rod Bearings

Connecting rod bearings are precision insert type and do not utilize shims for adjustment. Do not file rods or rod caps. If clearances are found to be excessive, a new bearing will be required. Bearings are available in standard size and undersize for new and used standard size crankshafts and reconditioned crankshafts.

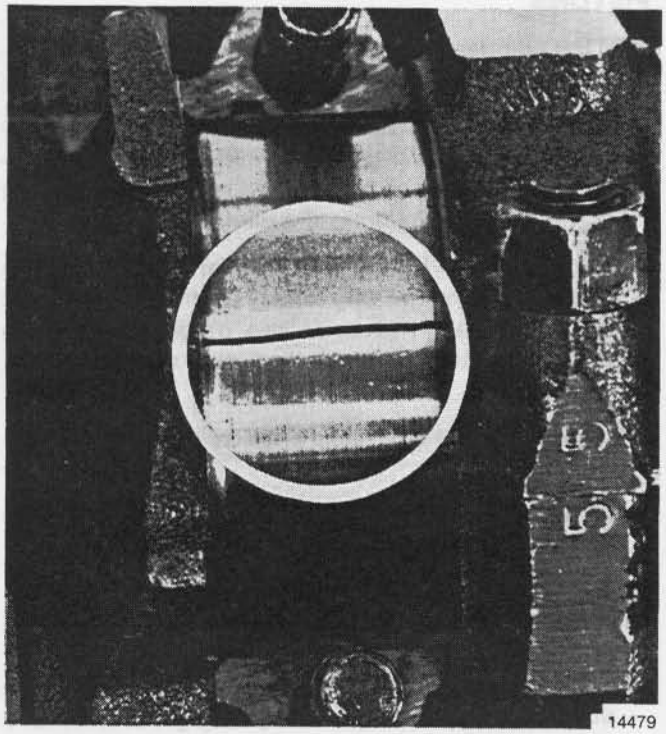
Inspection and Replacement

1. With oil pan and oil pump removed, remove connecting rod cap and bearing.
2. Inspect bearing for wear or damage and replace unsatisfactory bearings.
3. Wipe bearings and crankpin clean of oil.
4. Measure crankpin for out-of-round or taper with a micrometer. If not within specifications, replace or recondition crankshaft. If within specifications, and a new bearing is to be installed, measure maximum diameter of crankpin to determine new bearing size required.
5. Measure new or used bearing clearances with Plastigage or its equivalent.

IMPORTANT: If a bearing is being fitted to an out-of-round crankpin, be sure to fit to maximum diameter of crankpin. If bearing is fitted to minimum diameter, and crankpin is out-of-round .001 in. (.025mm) or more, interference between bearing and crankpin will result in rapid bearing failure.

a. Install bearing in connecting rod and cap.

b. Place a piece of gauging plastic the full width of crankpin (parallel to crankshaft), as shown.

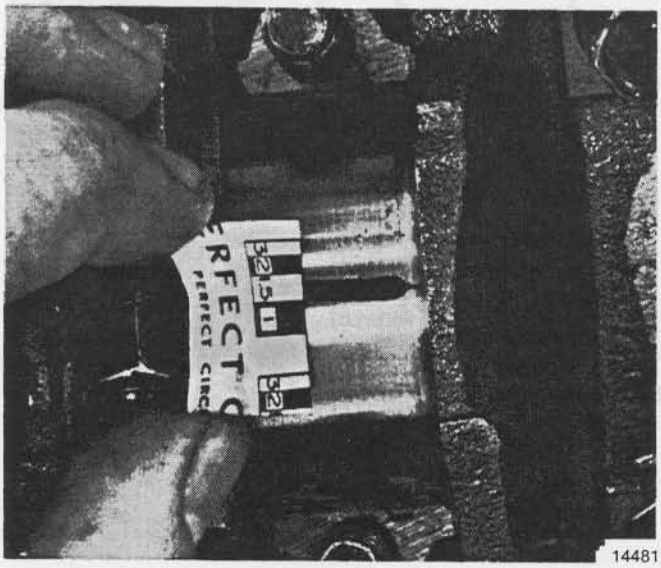


14479

c. Install bearing cap and torque nuts evenly to 50 lb. ft. (68 N·m).

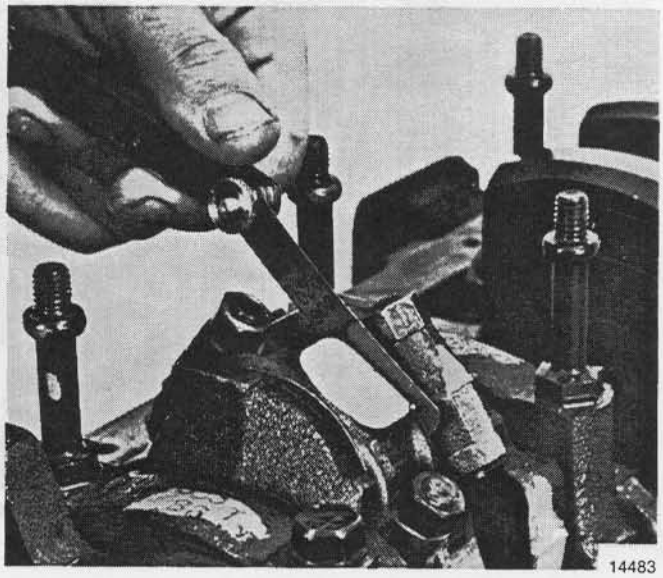
IMPORTANT: Do not turn crankshaft with gauging plastic installed.

d. Remove bearing cap and, using scale on gauging plastic envelope, measure gauging plastic width at the widest point, as shown.



14481

6. If clearance exceeds specifications, select a new, correct size bearing and recheck clearance.
7. Coat bearing surface with oil, install rod cap and torque nuts to 50 lb. ft. (68 N·m).
8. When all connecting rod bearings have been installed, tap each rod lightly (parallel to crankpin) to make sure they have clearance.
9. Measure all connecting rod side clearances (see specifications) between connecting rod caps, as shown.



14483

Connecting Rod/Piston Assembly

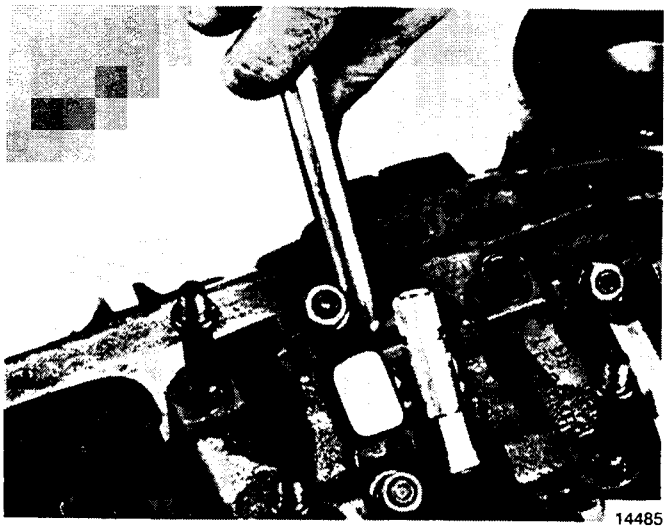
Removal

1. Remove as outlined:
   a. Oil pan and dipstick tube
   b. Baffle and oil pump
   c. Distributor and intake manifold
   d. Cylinder heads
2. Use a ridge reamer to remove any ridge and/or deposits from upper end of cylinder bore.

IMPORTANT: Before ridge and/or deposits are removed, turn crankshaft until piston is at bottom of stroke and place a cloth on top of piston to collect cuttings. After ridge and/or deposits are removed, turn crankshaft until piston is at top of stroke, then remove cloth and cuttings.

3. Mark connecting rod and bearing caps (left bank 1, 3, 5 and 7; right bank 2, 4, 6 and 8 from front to rear on same side as piston thrust).
4. Remove connecting rod caps and install Tool J-5239 on 3/8 in. rod bolts or Tool J-35228 on 7/16 in. rod bolts to protect crankshaft bearing journals. Push connecting rod and piston out of cylinder.

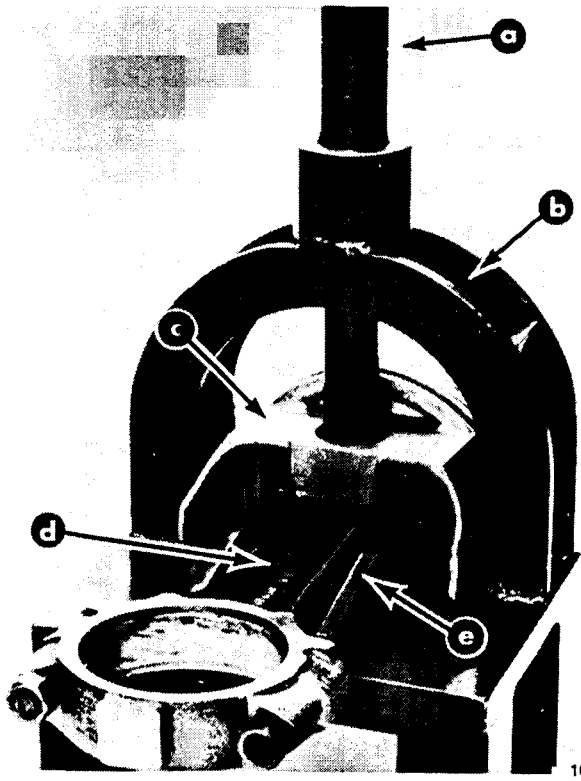
NOTE: It will be necessary to turn crankshaft slightly to disconnect and remove some connecting rod and piston assemblies.


14485

Removing Piston Assembly

Disassembly

Disassemble piston from connecting rod using Kit J-24086-B as shown. Follow instructions supplied with kit.



10072

Cleaning and Inspection

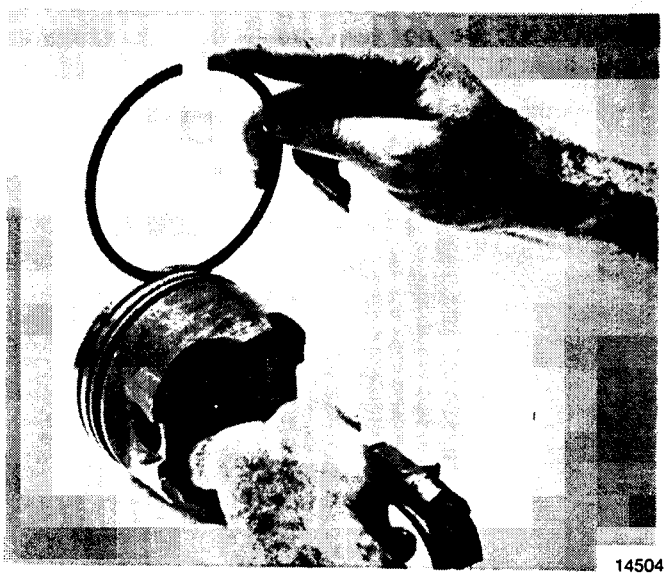
CONNECTING RODS

1. Wash connecting rods in cleaning solvent and dry with compressed air.
2. Check for twisted or bent rods and inspect for nicks or cracks. Replace damaged connecting rods.

PISTONS

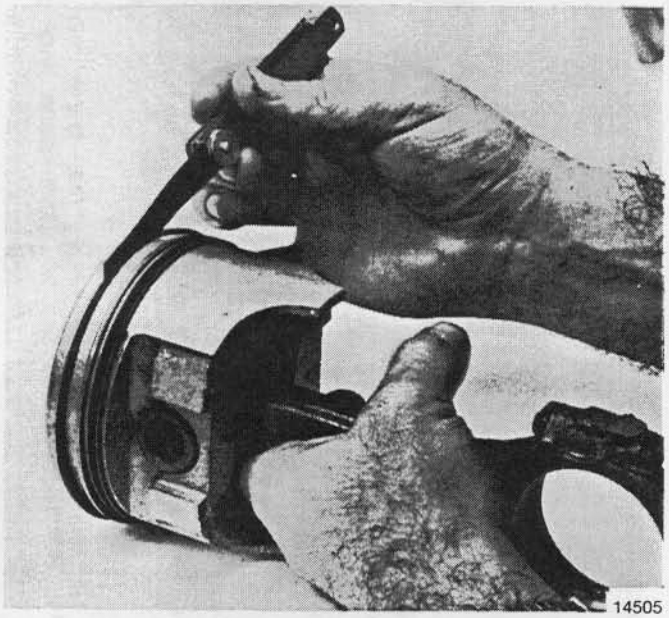
NOTE: Cylinder bore and taper must be within specifications before pistons can be considered for reuse.

1. Clean varnish from piston skirts with a cleaning solvent. DO NOT WIRE BRUSH ANY PART OF PISTON. Clean ring grooves with a groove cleaner and make sure oil ring holes are clean.
2. Inspect piston for cracked ring lands, skirts or pin bosses, wavy worn ring lands, scuffed or damaged skirts or eroded areas at top of piston. Replace pistons which are damaged or show signs of excessive wear.
3. Inspect grooves for nicks or burrs that might cause rings to hang up.
4. Measure piston skirt and check clearance as outlined under "Piston Selection."
5. Slip outer surface of a new top and second compression ring into respective piston ring groove and roll ring entirely around the groove to make sure that ring is free as shown. If binding occurs at any point, determine cause. If caused by ring groove, remove by dressing with a fine cut file. If binding is caused by a distorted ring, recheck with another ring.


14504

Rolling Ring in Ring Groove

6. Proper clearance of piston ring in its piston ring groove is very important to provide proper ring action and reduce wear. Therefore, when fitting new rings, clearances between ring and groove surfaces should be measured. See "Specifications."



Checking Groove Clearance

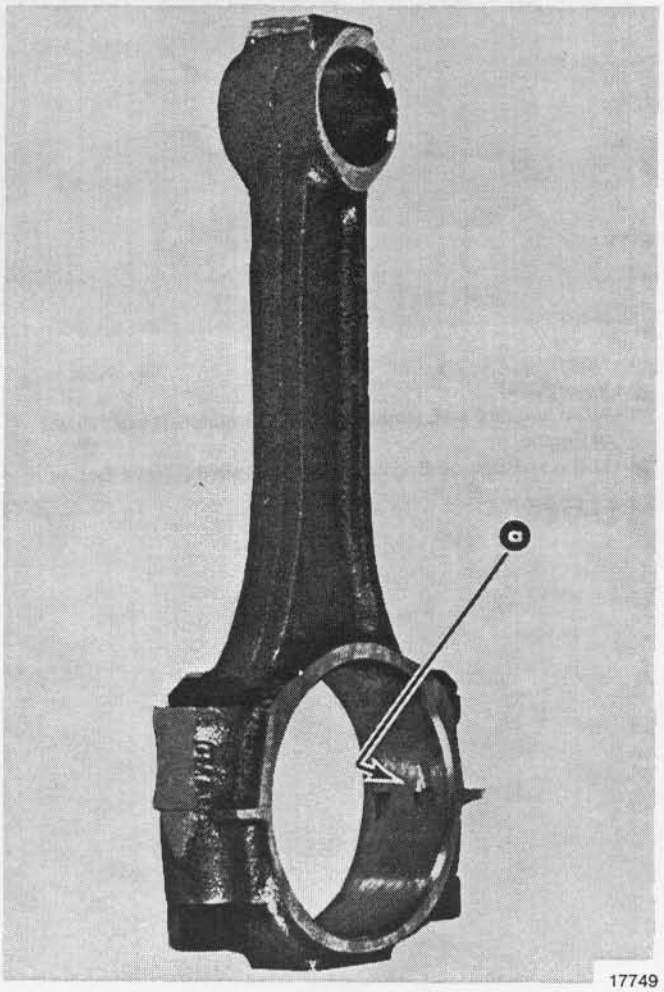
PISTON PINS

1. Piston pin clearance is designed to maintain adequate clearance under all engine operating conditions. Because of this, piston and piston pin are a matched set and not serviced separately.
2. Inspect piston pin bores and piston pins for wear. Piston pin bores and piston pins must be free of varnish or scuffing when measured. Measure piston pin with a micrometer and piston pin bore with a dial bore gauge or inside micrometer. If clearance is in excess of the .001 in. (.02mm) wear limit, replace piston and piston pin assembly.

Reassembly

IMPORTANT: When reassembling pistons and connecting rods, the following must be kept in mind.

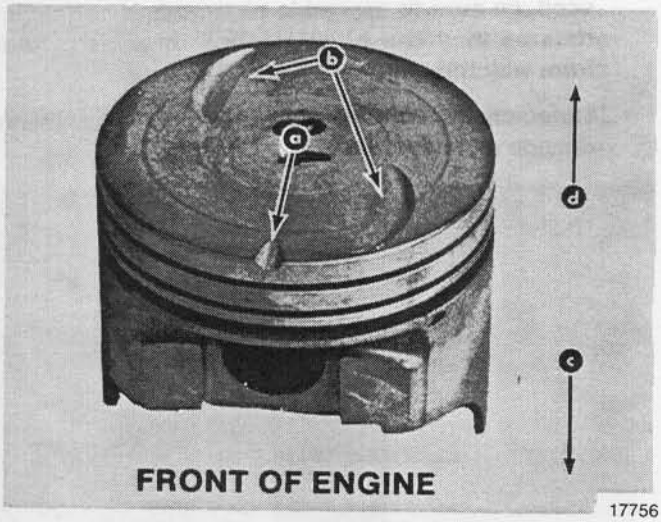
- **Piston and pin are machine fitted to each other and must remain together as a matched set. Do not intermix pistons and pins.**
- **If original pistons and/or connecting rods are being used, be sure to assemble pistons and connecting rods so they can be reinstalled in same cylinder from which they were removed.**
- **Connecting rod bearing tangs (a) are always toward outside of cylinder block.**



a - Connecting Rod Bearing Tangs Must Face Toward Outside of Cylinder Block

Connecting Rod

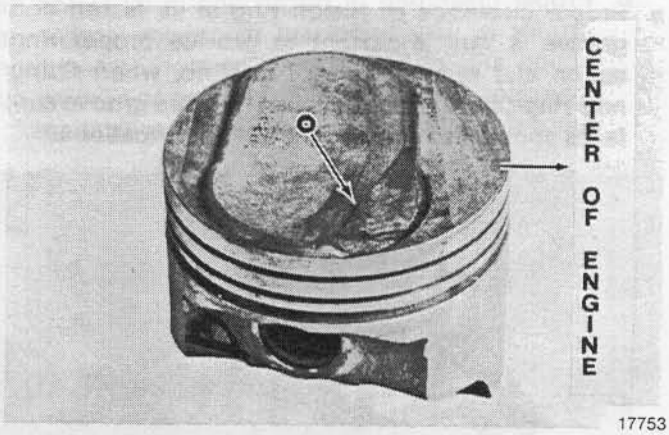
- **To determine if engine is left-hand (standard) rotation or right-hand (opposite) rotation, inspect camshaft drive. If engine has a timing chain, engine is left-hand rotation. If engine has timing gears, engine is right-hand rotation. All MCM engines are left-hand rotation.**
- **Notch (a) on piston, must be positioned correctly for engine that is being repaired.**



17756

a - Notch
b - Valve Relief
c - MCM and MIE L.H. Rotation Engines - Notch Toward Front of Engine
d - MIE R.H. Rotation Engines - Notch Toward Rear of Engine

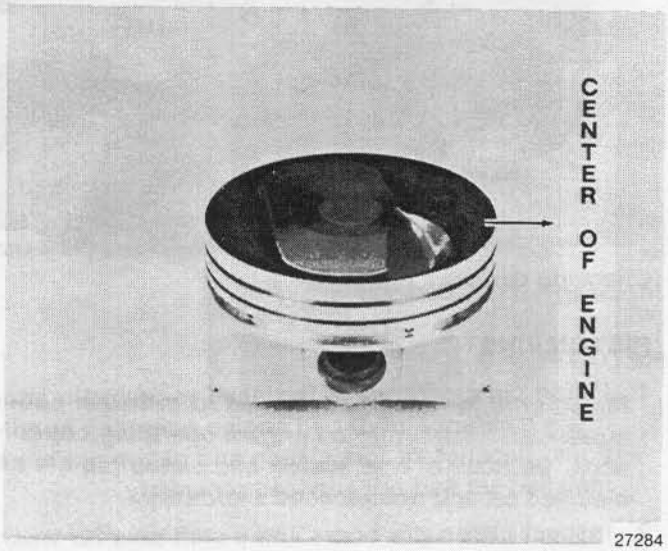
7.4 LITRE



17753

a - Valve Relief - Toward Center of Engine

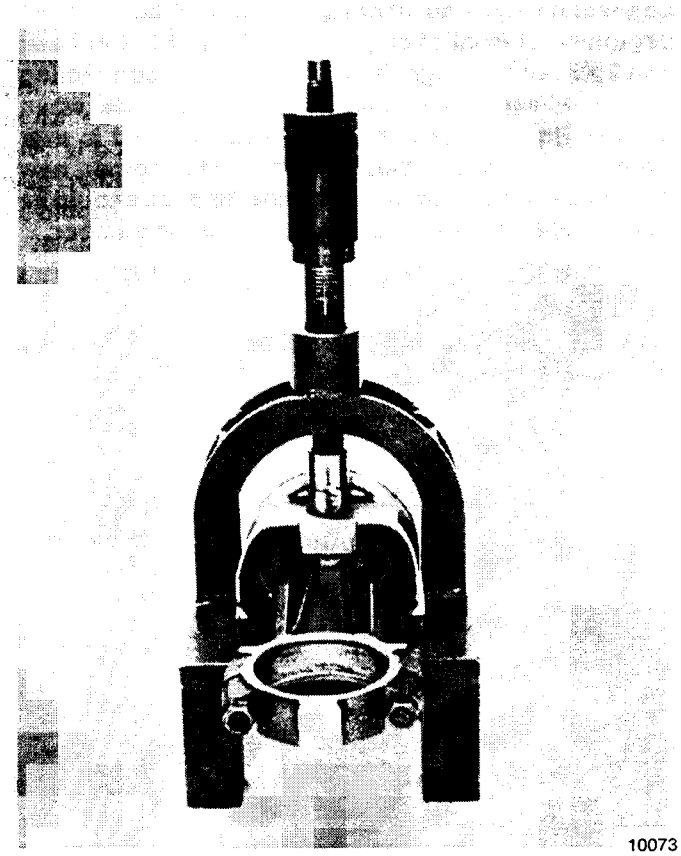
454 MAGNUM



27284

8.2 LITRE/502 MAGNUM

1. Assemble piston to connecting rod using Kit J-24086-B as shown. Follow instructions supplied with kit.



10073

Installing Piston Pin

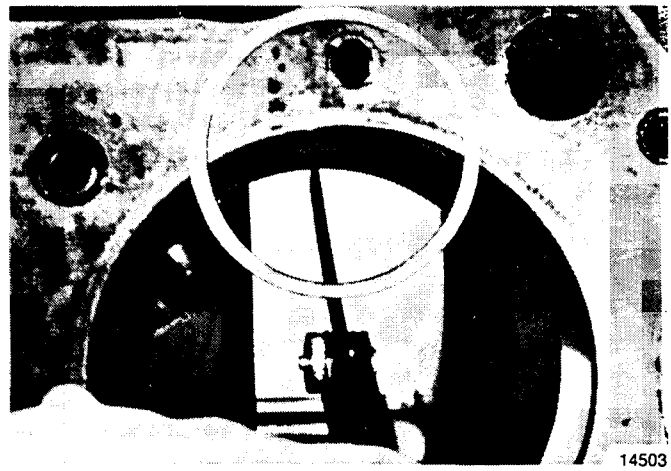
2. Once assembled, check piston for freedom of movement (back-and-forth and up-and-down) on connecting rod. Piston should move freely in all directions. If it does not, piston pin bore is tight and piston/pin assembly must be replaced.
3. If a new connecting rod has been installed, mark connecting rod and cap (on side of rod and cap with slots for connecting rod bearing tangs) with cylinder number in which it will be installed.

PISTON RINGS

All compression rings are marked on upper side of ring. When installing compression rings, make sure that marked side is toward top of piston.

Oil control rings are a 3-piece type, consisting of 2 rings and a spacer.

1. Select rings comparable in size to cylinder bore and piston size.
2. Slip compression ring in cylinder bore, then press ring down into cylinder bore about 1/4 in. (6mm) (below ring travel). Be sure that ring is square with cylinder wall.
3. Measure gap between ends of ring with a feeler gauge as shown.



14503

Checking Ring Gap

4. If gap between ends of ring is below specifications, remove ring and try another for fit.
5. Fit each compression ring to cylinder in which it is going to be used.
6. Clean and inspect pistons, if not previously done.
7. Install piston rings as follows:
   a. Install oil ring spacer in groove and insert anti-rotation tang in oil hole.
   b. Hold spacer ends butted and install lower steel oil ring rail with gap properly located.
   c. Install upper steel oil ring rail with gap properly located.
   d. Flex the oil ring assembly to make sure ring is free. If binding occurs at any point, the cause should be determined and, if caused by ring groove, remove by dressing groove with a fine cut file. If binding is caused by a distorted ring, check a new ring.

IMPORTANT: Use 91-24697 piston ring expander for compression ring installation.

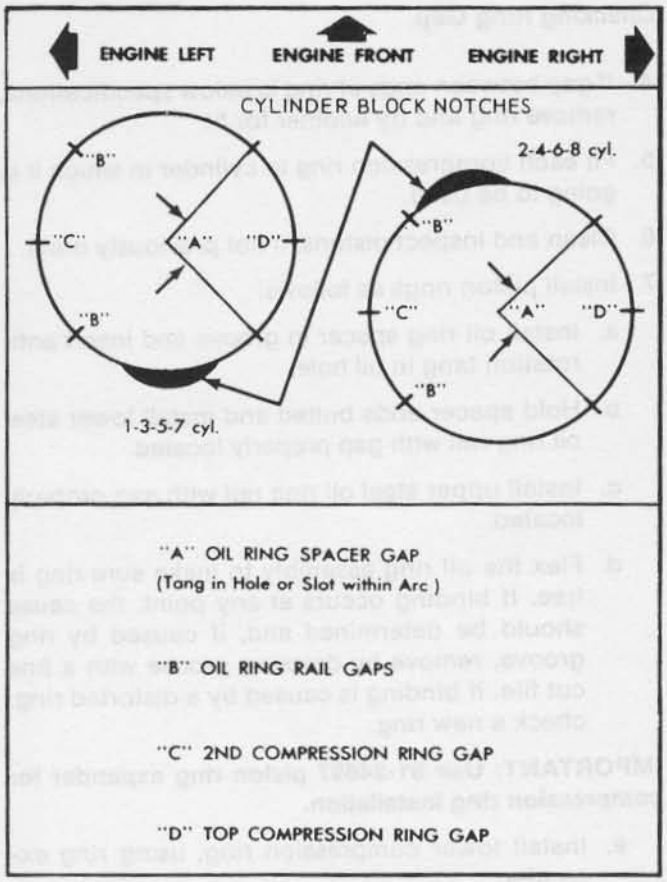
   e. Install lower compression ring, using ring expander.
   f. Install top compression ring using ring expander.

Installation

IMPORTANT: Cylinder bores must be clean before piston installation. Clean with a light honing, as necessary. Then clean with hot water and detergent wash. After cleaning, swab bores several times with light engine oil and a clean cloth, then wipe with a clean dry cloth.

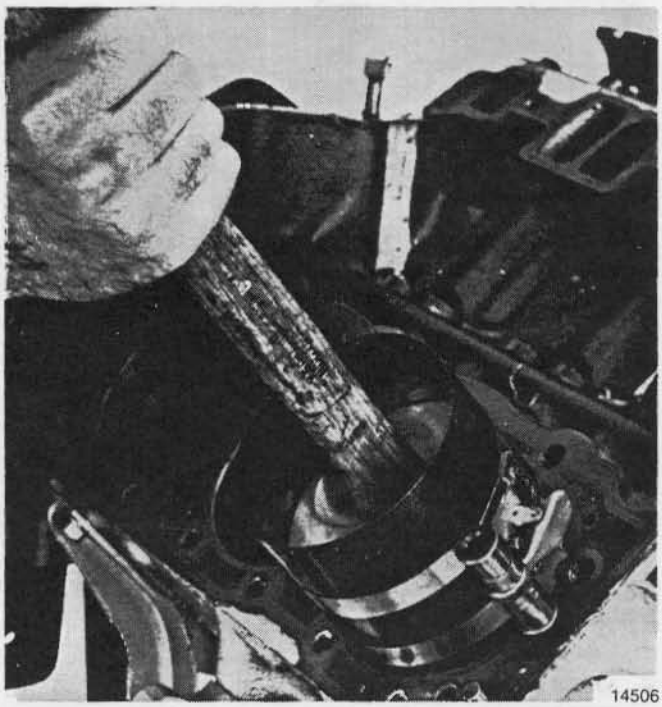
1. Lubricate connecting rod bearings and install in rods and rod caps.
2. Lightly coat pistons, rings and cylinder walls with light engine oil.
3. With bearing cap removed, install Tool J-5239 on 3/8 in. rod bolts or Tool J-35228 on 7/16 in. rod bolts to protect crankshaft bearing journals.

IMPORTANT: Be sure ring gaps are properly positioned as shown.



4. Install each connecting rod and piston assembly in its respective bore. Install with connecting rod bearing tangs toward outside of cylinder block. Use Tool J-8037 to compress rings. Guide connecting rod into place on crankshaft journal. Use a hammer handle with light blows to install piston into bore. Hold ring compressor firmly against cylinder block until all piston rings have entered cylinder bore.

IMPORTANT: Be sure to install new pistons in same cylinders for which they were fitted, and used pistons in same cylinder from which they were removed. Each connecting rod and bearing cap should be marked, beginning at front of engine (1, 3, 5 and 7 in left bank and 2, 4, 6 and 8 in right bank). Numbers on connecting rod and bearing cap must be on same side when installed in cylinder bore. If a connecting rod is ever transposed from one block or cylinder to another, new bearings should be fitted and connecting rod should be numbered to correspond with new cylinder number.



Installing Connecting Rod and Piston Assemblies

5. Remove Tool J-5239 or Tool J-35228.
6. Install bearing caps and torque nuts to 50 lb. ft. (68 N·m).
7. Check connecting rod side clearance.

NOTE: If bearing replacement is required, refer to "Connecting Rod Bearings."

8. Install as previously outlined:
   a. oil pump and baffle
   b. dipstick and oil pan
   c. cylinder heads
   d. intake manifold
   e. distributor
9. Fill crankcase with oil.
10. Adjust valves as outlined under "Valve Adjustment - Engine Stopped."

Crankshaft

Removal

1. Remove engine from boat.
2. Drain crankcase oil.
3. Remove as outlined:
   a. starter
   b. flywheel housing
   c. drive coupler/plate and flywheel
   d. belts
   e. water pump
   f. crankshaft pulley and torsional damper
   g. spark plugs
   h. oil pan and dipstick tube
   i. baffle and oil pump
   j. timing chain/gear cover
4. Turn crankshaft to align timing mark with camshaft mark.
5. Remove camshaft sprocket or gear.
6. Remove rear main seal and retainer.
7. Make sure all bearing caps (main and connecting rods) are marked so they can be reinstalled in their original locations.
8. Remove connecting rod bearing caps, then push piston and rod assemblies toward heads.
9. Remove main bearing caps and carefully lift crankshaft out of cylinder block.
10. If new main and/or connecting rod bearings are to be installed, remove main bearing inserts from cylinder block and bearing caps, and/or connecting rod bearing inserts from connecting rod and caps. Install new bearings following procedures outlined.

Cleaning and Inspection

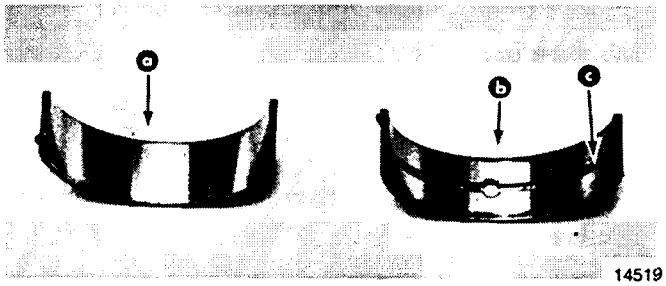
1. Wash crankshaft in solvent and dry with compressed air.
2. Measure main bearing journals and crankpin dimensions with a micrometer for out-of-round, taper or undersize (see "Specifications").
3. Check crankshaft for runout (by supporting at front and rear main bearings journals in "V" blocks) and check at front and rear intermediate journals with a dial indicator (see "Specifications").
4. Replace or recondition crankshaft if not within specifications.

Installation

1. If a new crankshaft is being installed, remove timing sprocket or gear from old crankshaft and reinstall on new crankshaft as outlined.

IMPORTANT: Be sure that all bearings and crankshaft journals are clean.

2. Install main bearings in engine block — refer to photo.



a - Lower Bearing Insert (install in Cap)
b - Upper Bearing Insert (install in Block)
c - Oil Groove

Main Bearing Inserts

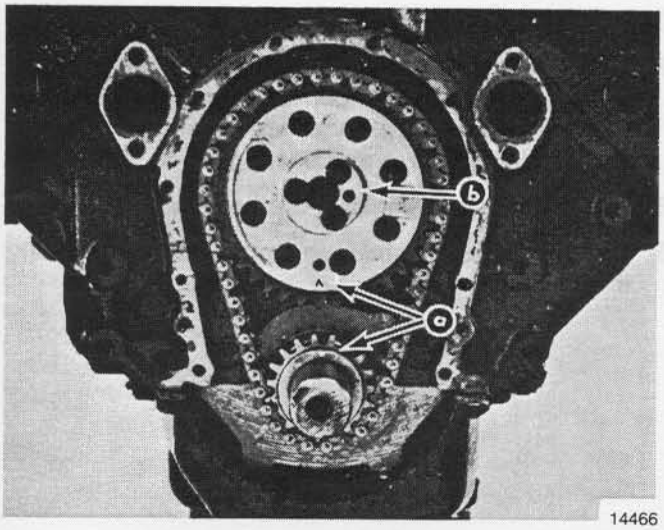
3. Carefully lower crankshaft into place. Be careful not to damage bearing surface.
4. Check clearance of each main bearing, following procedure outlined under "Main Bearings." If bearing clearances are satisfactory, apply engine oil to journals and bearings.
5. Install main bearing caps. Torque bolts to 110 lb. ft. (149 N·m). When tightening rear main cap, follow procedure outlined under "Main Bearings."
6. Check crankshaft end play as outlined.
7. Check clearance for each connecting rod bearing, following procedure under "Connecting Rod Bearings." If bearing clearances are satisfactory, apply engine oil to journals and bearings.
8. Install rod caps and torque nuts to 50 lb. ft. (68 N·m).
9. Turn crankshaft so mark on timing sprocket or gear is facing camshaft.

10. Install as outlined:
    a. timing chain and sprocket or gear on camshaft - align marks with crankshaft
    b. timing chain/gear cover
    c. oil pump and baffle
    d. dipstick tube and oil pan
    e. spark plugs
    f. crankshaft damper and crankshaft pulley
    g. water pump
    h. belts
    i. flywheel and drive coupler/plate
    j. flywheel housing
    k. starter
11. Install new oil filter. Fill crankcase with oil.

Timing Chain/Sprockets Left-Hand (Standard) Rotation Engines

Removal

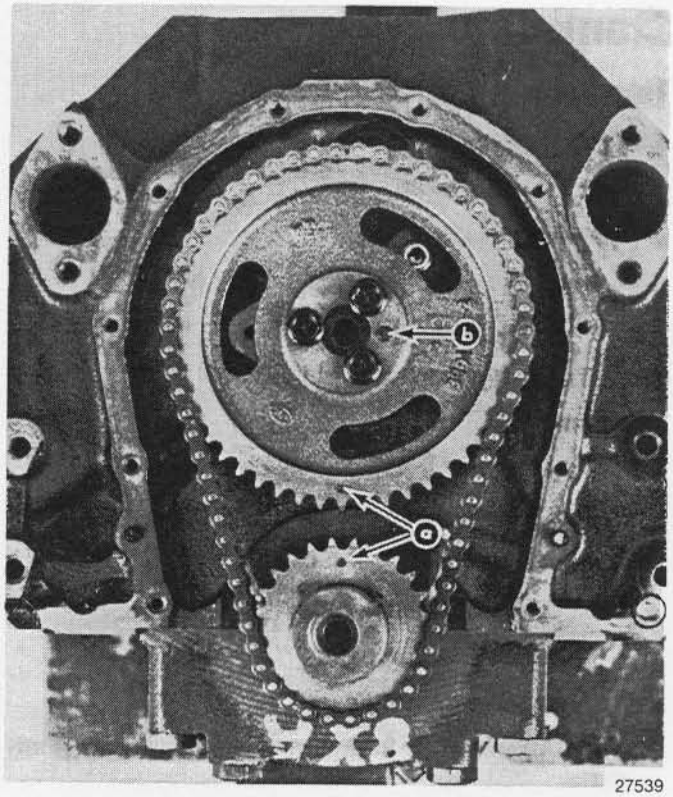
1. Remove crankshaft damper and crankcase front cover as outlined.
2. Crank engine until marks on camshaft and crankshaft sprockets are in alignment.



14466

a - Timing Marks Aligned
b - Locating Pin

Aluminum/Nylon Camshaft Sprocket



27539

a - Timing Marks Aligned
b - Locating Pin

All Metal Camshaft Sprocket

4. Remove camshaft sprocket and timing chain together. If sprocket does not come off easily, a light blow on lower edge of sprocket (with a plastic mallet) should dislodge the sprocket.
5. If crankshaft sprocket has to be replaced, remove as outlined in "Crankshaft Sprocket/Gear."

Cleaning and Inspection

1. Clean all parts in solvent and dry with compressed air.
2. Inspect timing chain for wear or damage.
3. Inspect sprockets for wear or damage.

Installation

1. If crankshaft sprocket was removed, install as outlined in "Crankshaft Sprocket/Gear."
2. Install timing chain on camshaft sprocket. Hold sprocket vertical with chain hanging down. Align marks on camshaft and crankshaft sprockets.

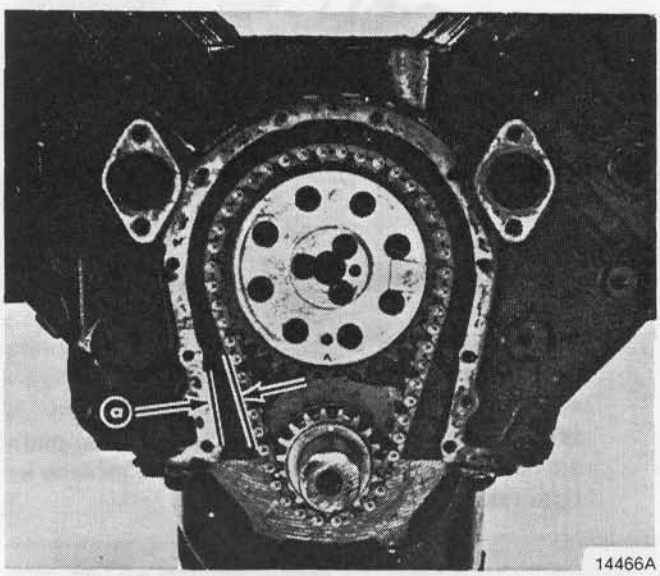
IMPORTANT: Do not attempt to drive sprocket on camshaft, as welsh plug at rear of engine can be dislodged.

3. Install sprocket on camshaft. Torque bolts to 20 lb. ft. (27 N·m).
4. Lubricate timing chain with engine oil. Install crankcase front cover and crankshaft damper as outlined.

Checking Timing Chain Deflection

With timing chain and sprockets installed, check timing chain deflection, as follows:

1. Rotate camshaft (in either direction) to place tension on one side of the chain.
2. Establish a reference point on the block (on taut side of chain) and measure from this point to the chain.
3. Rotate camshaft in the opposite direction to slacken the chain, then force chain out with fingers and again measure the distance between reference point and timing chain.
4. The deflection is the difference between these two measurements. If the deflection exceeds specifications, timing chain should be replaced.



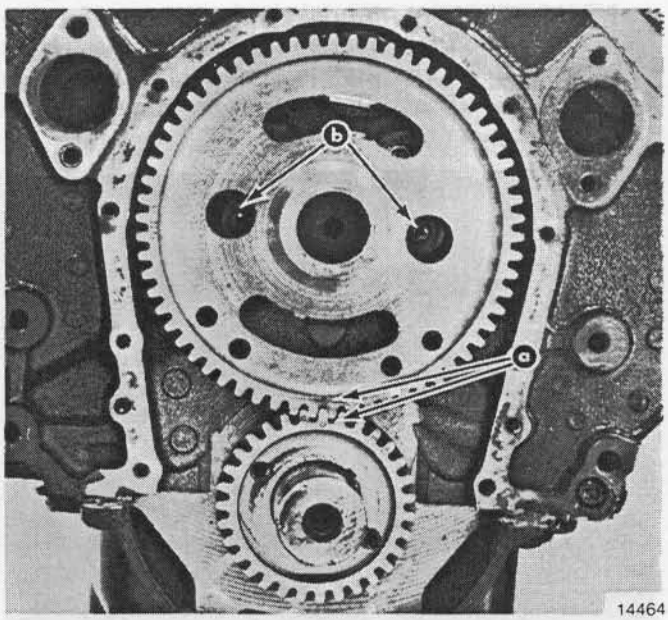
a - Reference Point

Checking Timing Chain Deflection

Timing Gears Right-Hand (Opposite) Rotation Engines

Removal

1. Remove crankcase front cover.
2. Crank engine over until timing mark on camshaft gear aligns with timing mark on crankshaft timing gear.



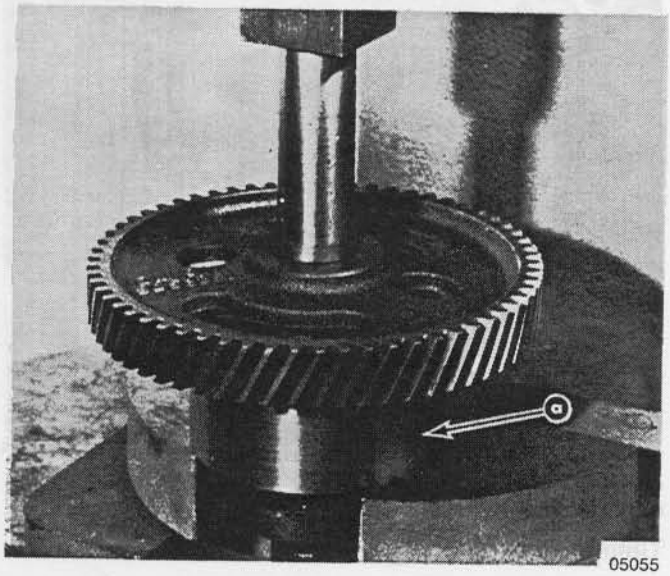
a - Timing Marks
b - Thrust Plate Attaching Screws

Timing Marks Aligned

3. Remove camshaft timing gear attaching screws through holes in timing gear.

IMPORTANT: Use extreme care when removing camshaft (in next step) to prevent damaging camshaft bearings. All camshaft journals are the same size.

4. To remove camshaft and gear as an assembly, refer to "Camshaft" (see "Index").
5. If camshaft, timing gear or thrust plate requires replacement, press gear off of camshaft, using an arbor press and appropriate tools as shown. Be sure to use a support under gear to prevent pressing on thrust plate. If camshaft is to be replaced, remove (and discard) woodruff key from camshaft and remove spacer ring.



a - Support (Must Clear Thrust Plate)

Removing Camshaft Gear

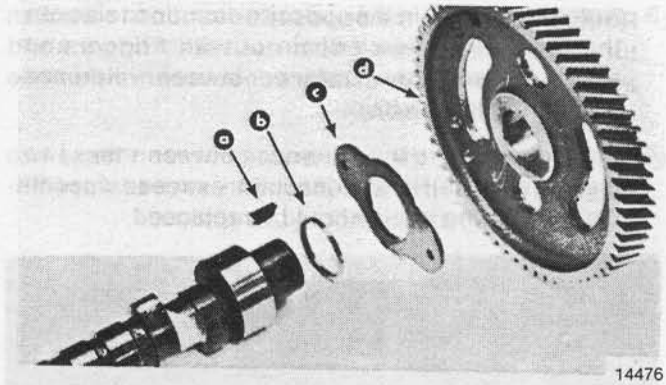
6. If crankshaft timing gear requires replacement, remove as outlined in "Crankshaft Sprocket/Gear," (see "Index").

Cleaning and Inspection

1. Clean all parts in solvent and dry with compressed air.
2. Inspect timing gears for worn or damaged teeth.

Installation

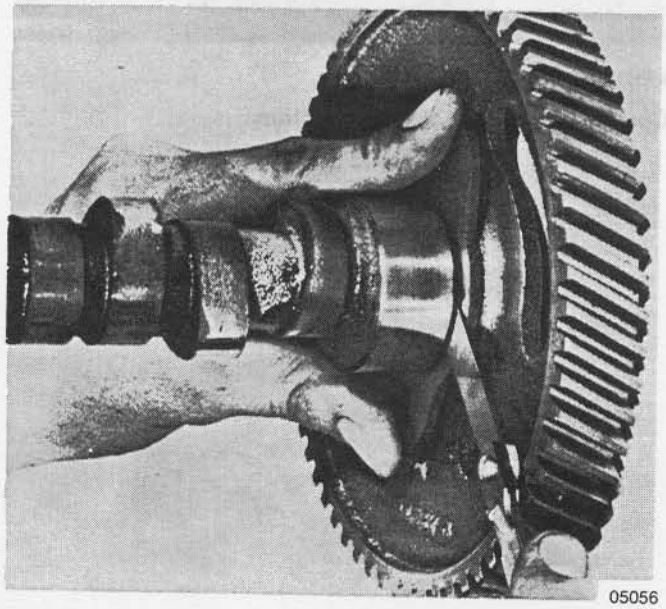
1. If removed, install crankshaft timing gear as outlined in "Crankshaft Sprocket/Gear."
2. If removed, install spacer ring, woodruff key, thrust plate and timing gear on camshaft, as follows:
   a. Check mating surface on camshaft and timing gear to ensure that they are clean and free of burrs.
   b. Install spacer on camshaft with chamferred side toward camshaft.
   c. Install new woodruff key.
   d. Place thrust plate on end of camshaft with grooved side outward.
   e. Firmly support camshaft at back of front journal in an arbor press and press timing gear onto camshaft with timing mark outward.



a - Woodruff Key
b - Spacer Ring
c - Thrust Plate
d - Timing Gear

Installing Camshaft Timing Gear and Related Parts

   f. Check camshaft front journal to thrust plate clearance (end play) with feeler gauge. If clearance is not as specified, make sure gear is pressed on all the way. Also check thrust plate and camshaft for excessive wear and replace as required.

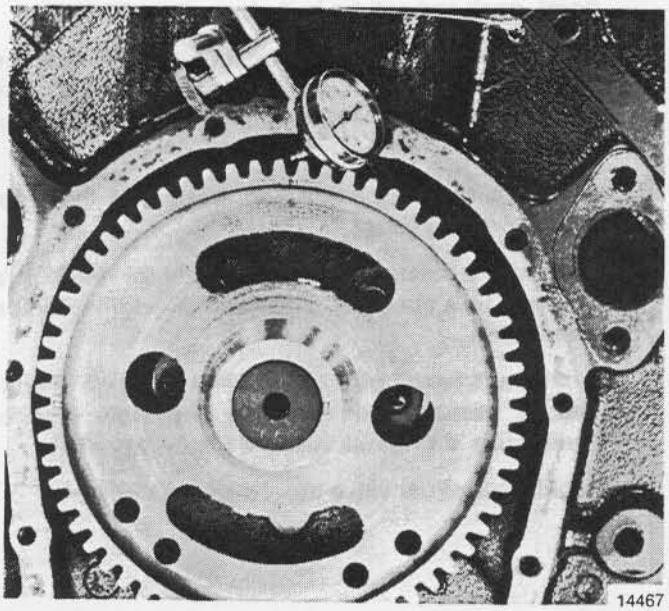


Checking End Play

3. Lubricate camshaft journals with engine oil and install camshaft being sure to align timing marks.
4. Install thrust plate attaching screws and torque to specifications.
5. Check timing gear backlash and runout as explained under "Checking Backlash and Runout."
6. Lubricate timing gears with engine oil.
7. Install crankcase front cover and crankshaft damper, as explained.
8. Install hydraulic valve lifters, push rods, rocker arms and rocker arm covers as previously explained.

Checking Backlash and Runout

1. Remove fuel pump and fuel pump push rod.
2. Loosen rocker arm nuts (to relieve tension on hydraulic valve lifters).
3. With timing gears installed, check camshaft to crankshaft gear backlash, as follows:
   a. Mount a dial indicator on engine so that indicator stem contacts one of the teeth on camshaft gear. Indicator stem should be as perpendicular to gear tooth surface as possible.
   b. Check the backlash between the camshaft gear and crankshaft gear while applying inward pressure on camshaft gear.
   c. If backlash is not within specifications, check for improperly machined parts or for worn camshaft or crankshaft bearings. If bearings check out good, replace both timing gears.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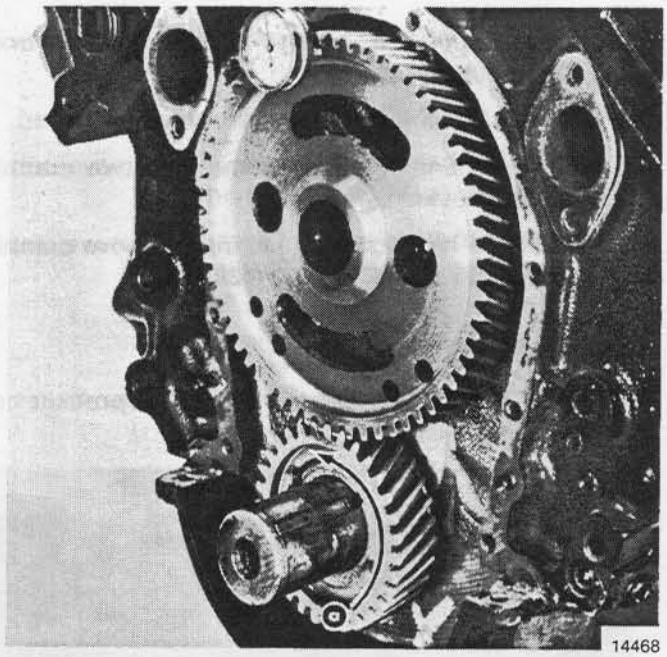
Checking Backlash

4. With timing gear installed, check camshaft and crankshaft timing gear runout, as follows: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a - Turn Crankshaft In This Direction

Checking Gear Runout

   a. Mount dial indicator on block so that indicator stem is perpendicular to camshaft timing gear and contacts gear surface just adjacent to teeth.
   b. Apply outward pressure on timing gear and zero indicator, then turn crankshaft as shown. Check gear runout through one complete revolution of camshaft gear.
   c. If not within specifications, check for burrs or foreign material between gear and camshaft joining surfaces. If none is found, replace both timing gears.
   d. Check crankshaft timing gear runout in same manner. Runout should not exceed specifications. Replace both gears, if runout is excessive.
5. Adjust valves as outlined under "Valve Adjustment - Engine Stopped."
6. Install fuel pump push rod and fuel pump.

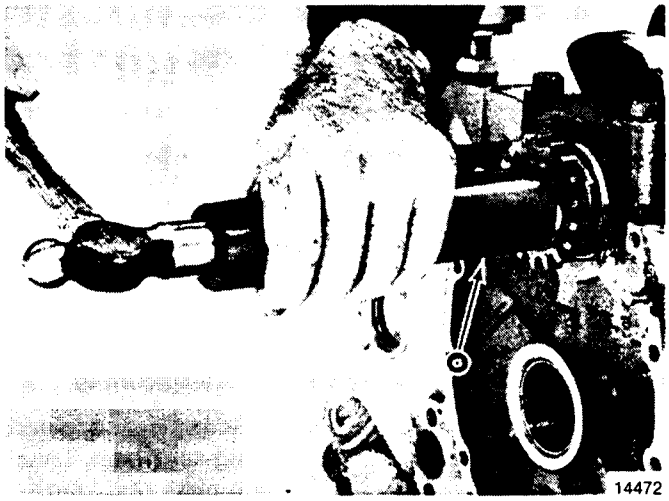
Crankshaft Sprocket/Gear

Removal

1. Remove crankshaft damper and crankcase front cover as outlined.
2. Remove camshaft timing chain/gear as outlined.
3. a. On left-hand rotation engines, remove crankshaft sprocket using Tool J-1619.
   b. On right-hand rotation engines, remove crankshaft gear using Tool J-24420-B.

Installation

1. Using Tool J-5590, as shown, install sprocket or gear on crankshaft.



a - Tool J-5590

2. Install timing chain or gear as outlined.
3. Install crankcase cover and crankshaft damper as outlined.

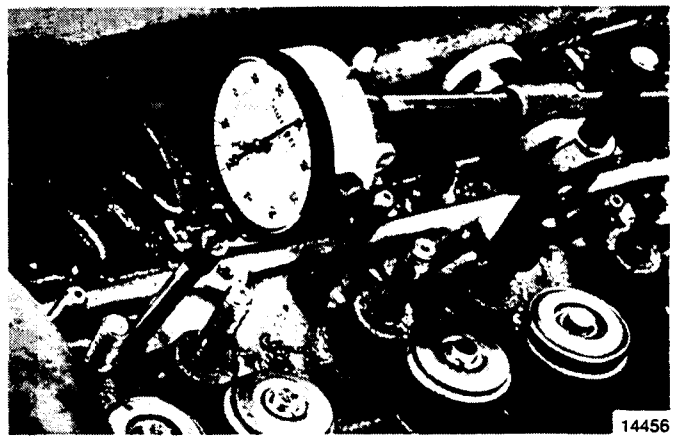
Camshaft

Measuring Lobe Lift

NOTE: Procedure is similar to checking valve timing. If improper valve operation is indicated, measure lift of each push rod in consecutive order and record readings.

1. Remove valve mechanism as outlined.
2. Position indicator with ball socket adapter Tool J-8520 on push rod. Be sure that push rod is in lifter socket.

NOTE: On Generation V Engines it will be necessary to temporarily install a suitable stud to which the J-8520 tool adaptor may be attached.

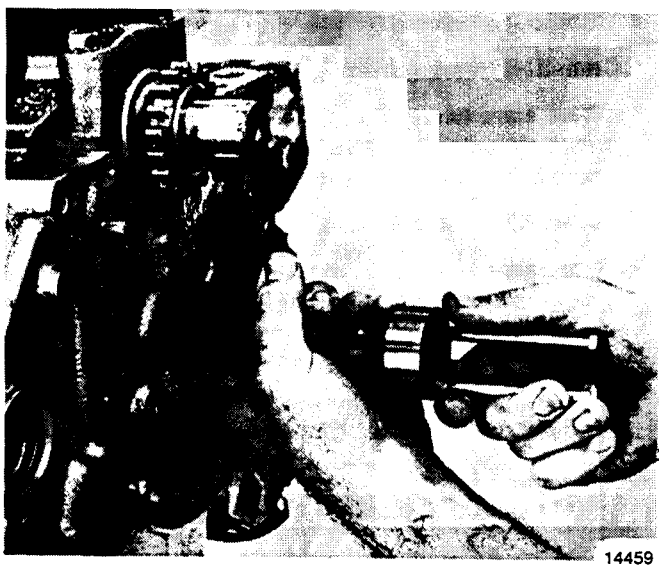


Measuring Camshaft Lobe Lift - Typical

3. Rotate crankshaft damper slowly in direction of rotation until lifter is on heel of cam lobe. At this point, push rod will be in its lowest position.
4. Set dial indicator on zero, then rotate balancer slowly (or attach an auxiliary starter switch and "bump" engine over) until push rod is in fully raised position.
5. Compare total lift, recorded from dial indicator, with "Specifications".
6. Continue to rotate engine until indicator reads zero. This will be a check on accuracy of original indicator reading.
7. If camshaft readings for all lobes are within specifications, remove dial indicator assembly, and on Generation V Engines remove temporary stud.
8. Install and adjust valve mechanism as outlined.

Removal

1. Remove valve lifters as outlined.
2. Remove crankcase front cover as outlined.
3. Remove fuel pump and fuel pump push rod.
4. Remove camshaft as follows:
   a. Remove timing chain and sprocket or timing gears as outlined.
   b. Install two 5/16-18 x 5 in. bolts in camshaft bolt holes and carefully remove camshaft as shown.



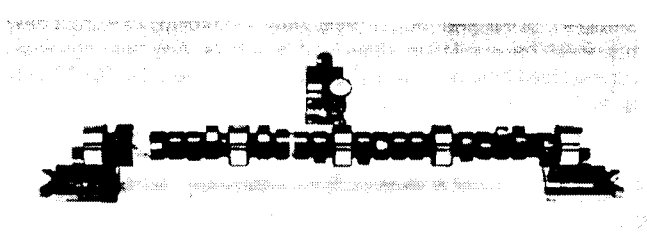
Removing Camshaft

Inspection

Measure camshaft bearing journals with a micrometer for out-of-round condition. If journals exceed .001 in. (.025mm) out-of-round, camshaft should be replaced.

Also check camshaft for alignment with "V" blocks and dial indicator which indicates exact amount camshaft is out-of-true. If out more than .002 in. (.051mm) (dial indicator reading) camshaft should be replaced.

On engines with timing gears, inspect camshaft gear and thrust plate for wear or damage.



Checking Camshaft Alignment

Installation

1. Install camshaft as follows:
   a. Install two 5/16-18 x 5 in. bolts in camshaft bolt holes, then lubricate camshaft journals with engine oil and install camshaft, being careful not to damage bearings.
   b. Lubricate camshaft lobes with General Motors Engine Oil Supplement or equivalent.
   c. Install timing chain or gears as outlined.
2. Install fuel pump push rod and fuel pump.
3. Install crankcase front cover and valve lifters as outlined.

Camshaft Bearings

Removal

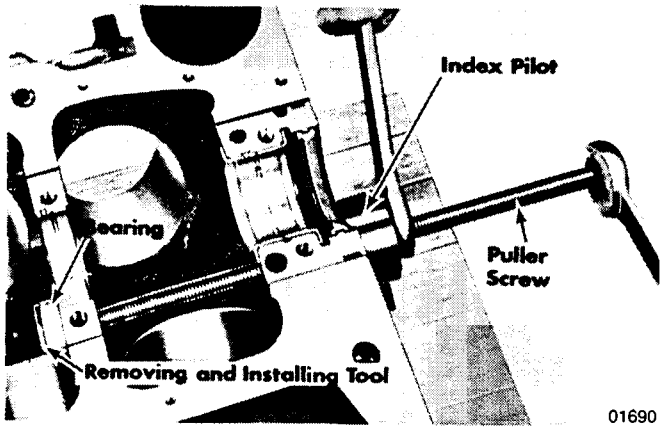
Camshaft bearings can be replaced while engine is disassembled for overhaul or without complete disassembly. To replace bearings without complete disassembly, remove camshaft and crankshaft, leaving cylinder heads attached and pistons in place. Before removing crankshaft, tape threads of connecting rod bolts to prevent damage to crankshaft. Fasten connecting rod against sides of engine so that they will not interfere while replacing camshaft bearings.

1. With camshaft and crankshaft removed, drive camshaft rear plug from cylinder block.

NOTE: This procedure is based on removal of bearings center of engine first, thus requiring a minimum amount of turns to remove all bearings.

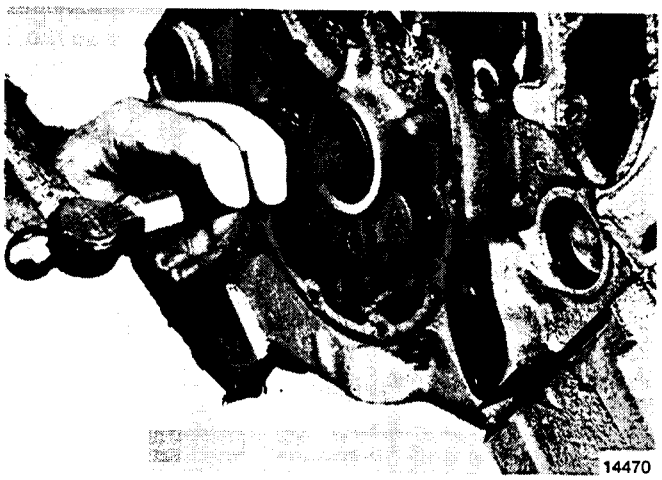
2. Using tool set J-6098-01 (with nut and thrust washer installed to end of threads), position pilot in front camshaft bearing and install puller screw through pilot.
3. Install tool with shoulder toward bearing. Be sure a sufficient amount of threads are engaged.
4. Using 2 wrenches, hold puller screw while turning nut. When bearing has been pulled from bore, remove tool and bearing from puller screw.

5. Remove remaining bearings (except front and rear) in same manner. It will be necessary to position pilot in rear camshaft bearing to remove rear intermediate bearing.



Replacing Camshaft Bearings

6. Assemble remover tool on driver handle and remove front and rear camshaft bearings by driving toward center of cylinder block.



Replacing Front and Rear Camshaft Bearings (5.0/5.7 Litre Engine Shown)

Inspection

Clean camshaft bearing bores in cylinder block with solvent and blow out with compressed air. Be sure grooves and drilled oil passages are clean.

Installation

Front and rear bearings must be installed last as pilot will not fit into bearing bores if bearings are installed.

Lubricate outer surface of new camshaft bearings with engine oil to ease installation.

⚠CAUTION

Avoid internal oil leakage and loss of oil pressure resulting in severe engine damage. Use only camshaft and bearing combinations specified for engine block bearing bore configuration.

IMPORTANT: All camshafts, camshaft bearings and engine block rear camshaft bearing bores are not the same.

Camshaft Rear Journals:

- **There are two types of camshaft rear journals - one with a groove in it (some service cams) and another without a groove (production engine camshafts).**

Camshaft Bearings:

- **There are two types of camshaft rear bearings - one with a single oil feed hole and another with a hole and two slots through the shell.**

Engine Block Rear Camshaft Bearing Bore:

- **There are two types of rear camshaft bearing bores - one with a groove machined in the bore and another without this groove.**

Select and use the appropriate camshaft bearing or set as shown by the following chart:

CAMSHAFT BEARING SELECTION CHART					
	CAMSHAFT JOURNAL			USE ONLY THE FOLLOWING REAR CAM BEARING	
		Camshaft Journal With No Groove	Camshaft Journal With Groove	Single Hole and Two Slots	Single Hole Only
ENGINE BLOCK REAR CAM BEARING BORE	Block WITHOUT Machined Groove		X	X	
	Block WITH Machined Groove	X			
			X	SEE NOTE	

NOTE: Install camshaft bearing set sold by Quicksilver (Part Number 23-85684), or Federal-Mogul (Part Number 1404M) camshaft bearings which have a .115 in. (3mm) oil feed hole. Any bearings with a larger oil feed hole WILL CAUSE OIL LEAKS. The COMPLETE bearing set must be used in the engine.

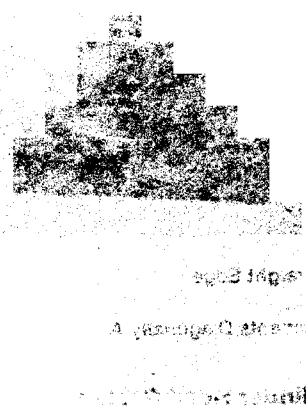
IMPORTANT: All camshaft bearings are not the same. Be sure to install correct bearing in proper location, indicated by "CAMSHAFT BEARING SELECTION CHART" (as previously given) and by bearing manufacturer, and to position bearings as follows: (Directional references regard engine in its normal operating position.)

- **454/502 (7.4/8.2L) CID Engine: Front, Intermediate and Center camshaft bearings must be installed so that oil hole in each aligns with oil hole in block. Rear bearing bore is grooved and bearing oil hole must be positioned at or near the 6 o'clock position.**

1. **Installing Intermediate and Center Bearings:**
   a. Install nut and thrust washer all-the-way onto puller screw, then position pilot in front camshaft bearing bore and insert screw thru pilot.
   b. Index center camshaft bearing, then position appropriate size remover and installer tool in bearing and thread puller screw into tool. Be sure at least 1/2 in. (13mm) of threads are engaged.
   c. Using 2 wrenches, hold puller screw and turn nut until bearing has been pulled into position. Remove the remover and installer tool and check to ensure that oil hole(s) in bearing are positioned correctly.
   d. Install intermediate bearings in same manner being sure to index bearings correctly. It will be necessary to position pilot in rear camshaft bearing bore to install rear intermediate bearing.
2. **Installing Front and Rear Bearings:**
   a. Install appropriate size remover and installer tool on drive handle.
   b. Index front bearing (as explained in "Important"), and drive it into position with tool. Check position of oil hole(s) in bearing to ensure bearing is positioned correctly.
   c. Install rear bearing (refer to "Camshaft Bearing Selection Chart") in same manner, being sure to index bearing correctly.
3. Install a new camshaft rear plug.

IMPORTANT: Plug must be installed flush to 1/32 in. (0.8mm) deep and must be parallel with rear surface of cylinder block.

4. Install crankshaft and camshaft as outlined.



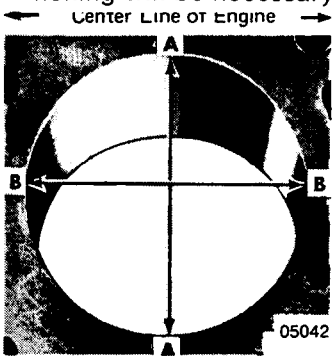
Cylinder Block

Cleaning and Inspection

1. Remove all engine components as previously outlined.
2. Wash cylinder block thoroughly in cleaning solvent and clean all gasket surfaces.
3. Remove oil gallery plugs and clean all oil passages.
4. Remove expansion plugs.

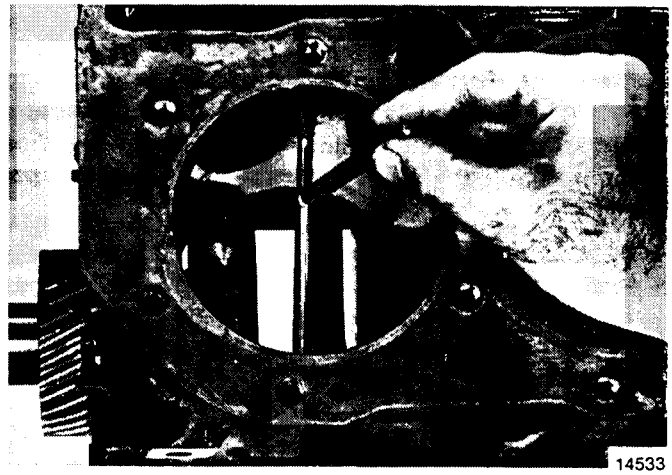
NOTE: These plugs may be removed with a sharp punch, or they may be drilled and pried out.

5. Clean and inspect water passages in cylinder block.
6. Inspect cylinder block for cracks in cylinder walls, water jacket valve lifter bores and main bearing webs.
7. Measure cylinder walls for taper, out-of-round or excessive ridge at top of ring travel. This should be done with a dial indicator or inside micrometer. Carefully work gauge up and down cylinder to determine taper and turn it to different points around cylinder wall to determine out-of-round condition. If cylinders exceed specifications, boring and/or honing will be necessary.

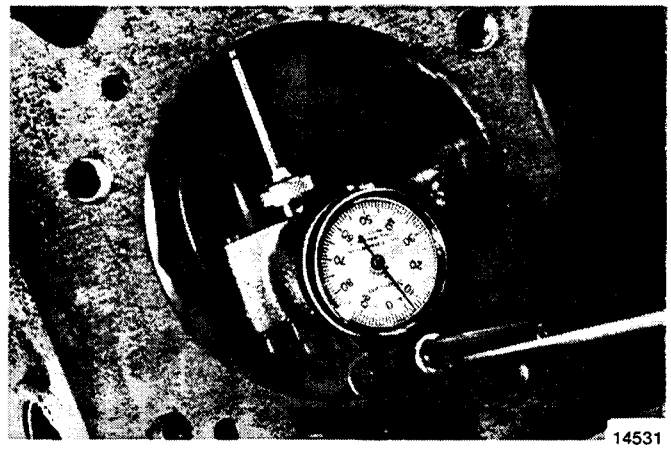


"A" = At right angle to centerline of engine
"B" = Parallel to centerline of engine
"Out-of-round" = Difference between "A" and "B"
"Taper" = Difference between measurement "A" at top of cylinder bore and "A" measurement at bottom of cylinder bore.

Cylinder Measurement

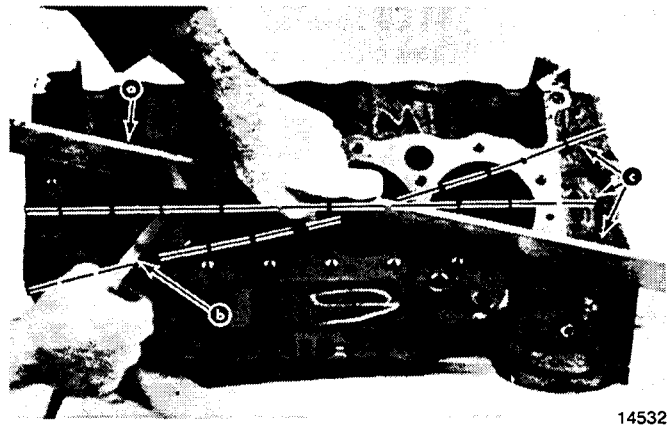


Measuring Cylinder Bore



Measuring Cylinder Bore

8. Check cylinder head gasket surfaces for warpage with a machinists straight edge and a feeler gauge, as shown. Take measurements diagonally across surfaces (both ways) and straight down center. If surfaces are out-of-flat more than .003 in. (0.07mm) in a 6 in. area or .007 in. (0.2mm) overall, block must be resurfaced by an automotive machine shop.



a - Machinists Straight Edge
b - Feeler Gauge
c - Take Measurements Diagonally Across Surface and Straight Down Center

Checking Cylinder Head Gasket Surfaces for Warpage

Cylinder Conditioning

1. Performance of the following operation depends upon engine condition at time of repair.
2. If cylinder block inspection indicates that block is suitable for continued use (except for out-of-round or tapered cylinders), they can be conditioned by honing or boring.
3. If cylinders have less than .005 in. (0.127mm) taper or wear, they can be conditioned with a hone and fitted with high limit standard size piston. A cylinder bore of less than .005 in. wear or taper may not clean up entirely when fitted to a high limit piston. To entirely clean up the bore, it will be necessary to rebore for an oversize piston. If more than .005 in. taper or wear, bore and hone to smallest oversize that will permit complete resurfacing of all cylinders.
4. When pistons are being fitted and honing is not necessary, cylinder bores may be cleaned with a hot water and detergent wash. After cleaning, swab cylinder bores several times with light engine oil and a clean cloth, then wipe with a clean dry cloth.

Cylinder Boring

1. Before using any type boring bar, file off top of cylinder block to remove dirt or burrs. This is very important to prevent boring bar tilt, with result that rebored cylinder wall is not at right angles to crankshaft.
2. Measure piston to be fitted with a micrometer, measuring at center of piston skirt and at right angles to piston pin. Bore cylinder to same diameter as piston and hone to give specified clearance.

NOTE: Hone cylinders as outlined under "Cylinder Honing" and "Piston Selection," following.

3. Carefully observe instructions furnished by manufacturer of equipment being used.

Cylinder Honing

1. Follow hone manufacturer's recommendations for use of hone and cleaning and lubrication during honing.
2. Occasionally, during the honing operation, thoroughly clean cylinder bore and check piston for correct fit in cylinder.
3. When finish-honing a cylinder bore to fit a piston, move hone up-and-down at a sufficient speed to obtain very fine uniform surface finish marks in a cross-hatch pattern of approximately 30° to cylinder bore. Finish marks should be clean but not sharp, free from imbedded particles and torn or folded metal.
4. Permanently mark piston (for cylinder to which it has been fitted) and proceed to hone cylinders and fit remaining pistons.

IMPORTANT: Handle pistons with care and do not attempt to force them through cylinder until cylinder is honed to correct size, as this type piston can be distorted by careless handling.

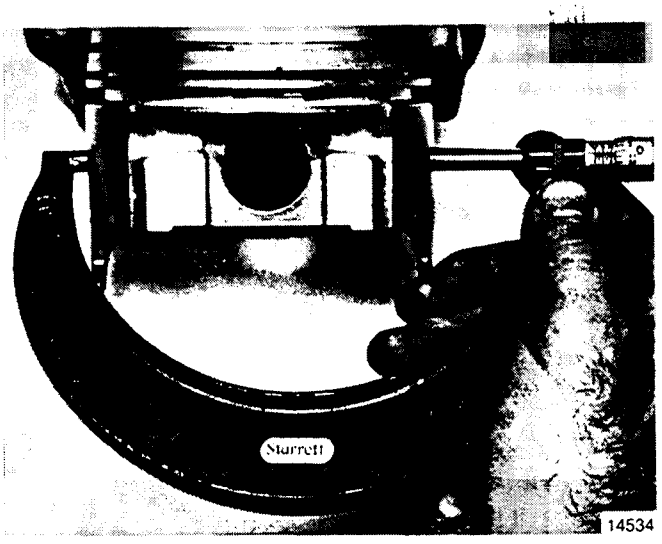
5. Thoroughly clean cylinder bores with hot water and detergent. Scrub well with a stiff bristle brush and rinse thoroughly with hot water. It is extremely essential that a good cleaning operation be performed. If any abrasive material remains in cylinder bores, it will rapidly wear new rings and cylinder bores in addition to bearings lubricated by the contaminated oil. Swab bores several times with light engine oil on a clean cloth, then wipe with a clean dry cloth. Cylinder should not be cleaned with kerosene or gasoline. Clean remainder of cylinder block to remove excess material spread during honing operation.

Piston Selection

1. Check used piston to cylinder bore clearance as follows:
   a. Measure "cylinder bore diameter" with a telescope gauge 2-1/2 in. (64mm) from top of cylinder bore as shown.

Measuring Cylinder Bore

b. Measure "piston diameter" at skirt across center line of piston pin as shown.



Measuring Piston

c. Subtract piston diameter from cylinder bore diameter to determine "piston-to-bore clearance."

d. Determine if "piston-to-bore clearance" is in acceptable range shown in "Specifications."

2. If used piston is not satisfactory, determine if a new piston can be selected to fit cylinder bore within acceptable range.

3. If cylinder bore must be reconditioned, measure new piston diameter (across centerline of piston pin), then hone cylinder bore to correct clearance (preferable range).

4. Mark piston to identify cylinder for which it was fitted.

Oil Filter By-Pass Valve and Adaptor Assembly

Inspection and/or Replacement

Oil by-pass valve and adaptor assembly should be inspected whenever engine is disassembled for major repair or whenever inadequate oil filteration is suspected.

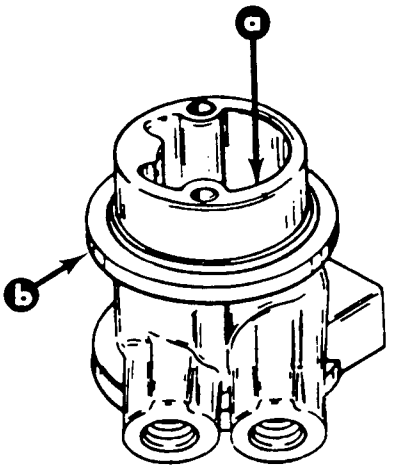
Refer to "Engine Parts List" when ordering parts for oil filter by-pass valve, adaptor assembly or remote oil filter parts.

1. Remove oil hoses and drain oil.
2. Remove oil filter adaptor assembly fitting or cover.
3. Remove oil filter adaptor assembly.
4. Clean adaptor assembly in solvent and dry with compressed air.
5. Follow instructions "a" or "b":

   a. **On engines with stamped steel rocker arm covers (Mark IV):** Inspect fiber valve [mounted in adaptor, item (a)] for cracks or other damage.

   b. **On engines with cast aluminum rocker arm covers (Generation V):** Inspect valve (mounted in engine block) for damage.

NOTE: On engines with stamped steel rocker arm covers (Mark IV) by-pass valve is part of oil filter adaptor and both are replaced as an assembly.



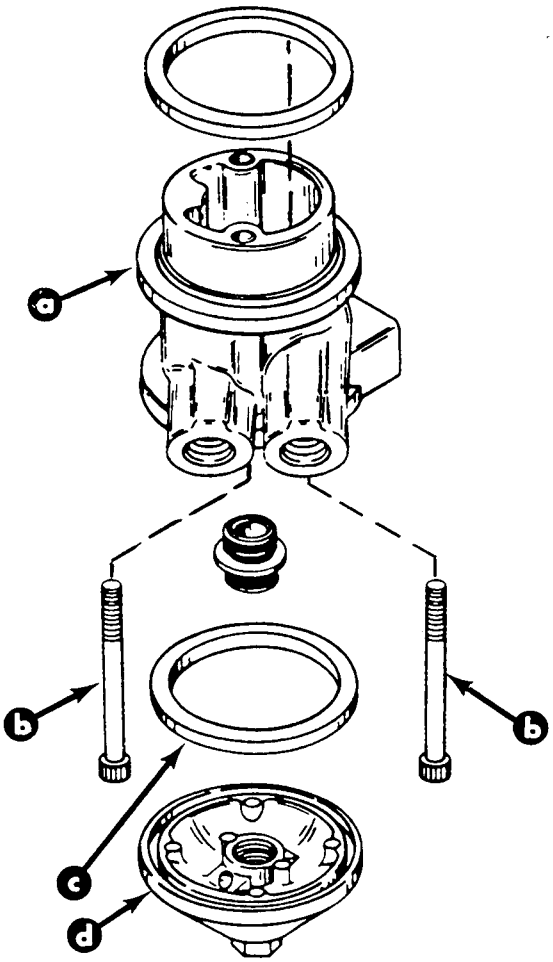
a - Fiber Valve (Not Visible In This View)
b - Adaptor

Typical (Except On Generation V)

6. Check that valve fits tightly against its seat. Push valve down and release it. Valve should return freely to its seat. If valve operation is questionable, by-pass valve should be replaced.

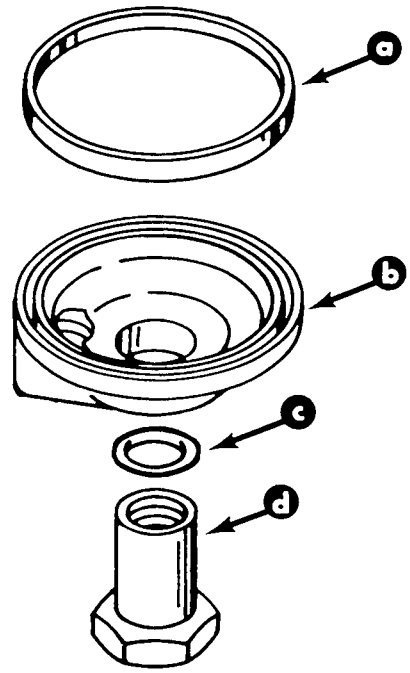
7. Follow instructions "a" or "b":

   a. **On engines with stamped steel rocker arm covers (Mark IV):** Install adaptor assembly with by-pass valve. Torque bolts to 20 lb. ft. (27 N·m). Lubricate cover seal with engine oil. Install cover and torque to 15 lb. ft. (20 N·m).



a - Adaptor Assembly (with By-Pass Valve)
b - Bolts
c - Seal, Cover
d - Cover

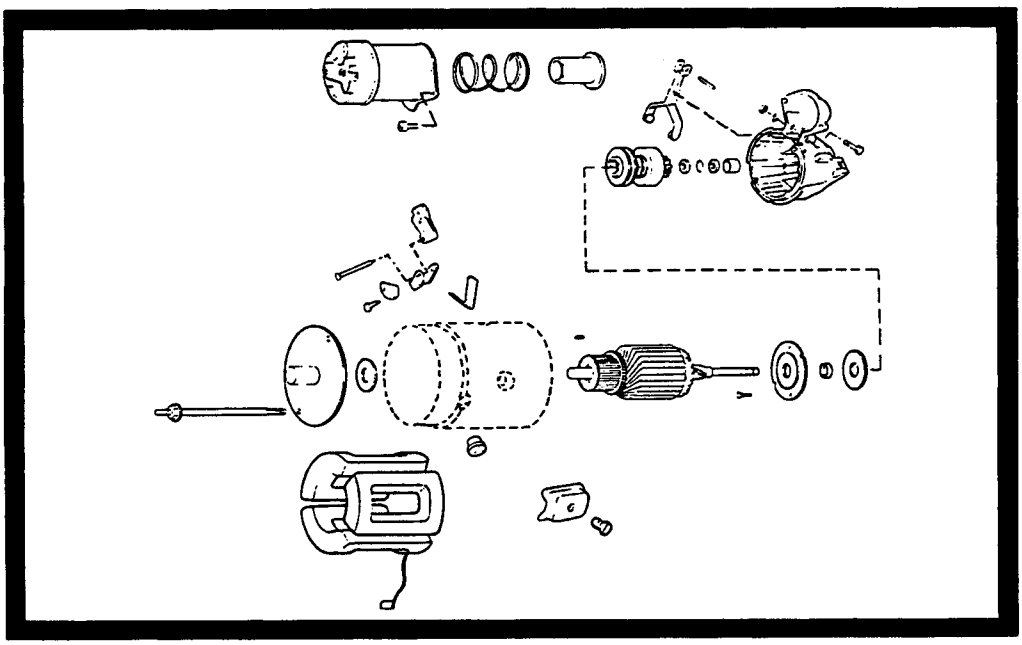
   b. **On engines with cast aluminum rocker arm covers (Generation V):** Install by-pass valve into engine block. Lubricate adaptor seal and position adaptor assembly. Install large fitting with seal and torque to 40 lb. ft. (54 N·m).



a - Seal, Adaptor
b - Adaptor
c - Seal, Fitting
d - Large Fitting

8. Apply Perfect Seal to hose threads. Install hoses and tighten securely.

ELECTRICAL SYSTEM



4

A

STARTING SYSTEM

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PERMANENT MAGNET GEAR REDUCTION (PMGR) STARTER MOTOR

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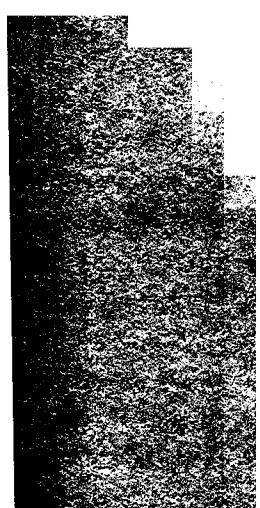
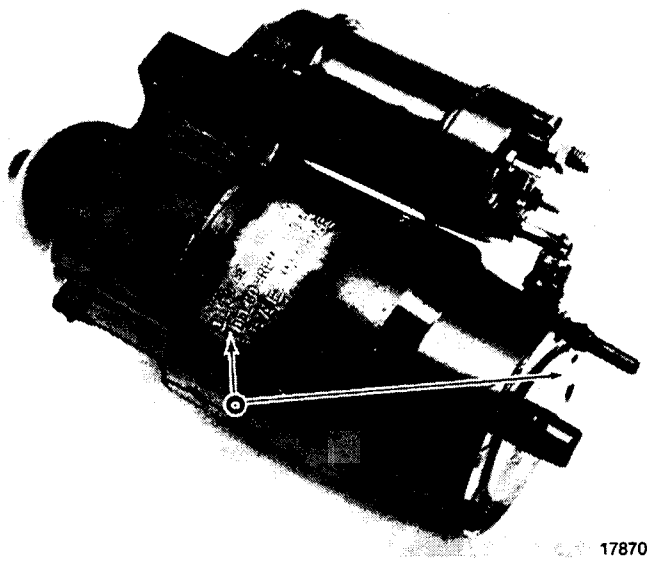


Identification

The starter identification number (a) is located as shown.



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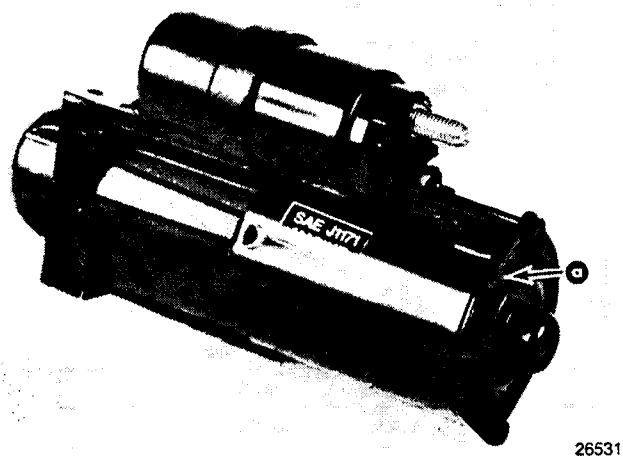
DIRECT DRIVE STARTER MOTOR



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PERMANENT MAGNET GEAR REDUCTION (PMGR) STARTER MOTOR

⚠WARNING
Electrical, ignition and fuel system components on your MerCruiser are designed and manufactured to comply with U.S. Coast Guard Rules and Regulations to minimize risks of fire and explosion.

Use of replacement electrical, ignition or fuel system components, which do not comply with these rules and regulations, could result in a fire or explosion hazard and should be avoided.

Battery

IMPORTANT: Terminals must be soldered to cable ends to ensure good electrical contact. Use electrical grade (resin flux) solder only. Do not use acid flux solder, as it may cause corrosion and failure.

Battery Cable

Cable Length	Cable Gauge
Up to 3-1/2 Ft. (1.1m)	4 (25mm²)
3-1/2 - 6 Ft. (1.1-1.8m)	2 (35mm²)
6 - 7-1/2 Ft. (1.8-2.3m)	1 (50mm²)
7-1/2 - 9-1/2 Ft. (2.3-2.9m)	0 (50mm²)
9-1/2 - 12 Ft. (2.9-3.7m)	00 (70mm²)
12 - 15 Ft. (3.7-4.6m)	000 (95mm²)
15 - 19 Ft. (4.6-5.8m)	0000 (120mm²)
Both positive (+) and negative (-) cables	

Maintenance

⚠WARNING
Hydrogen gases that escape from the battery during charging are explosive. Be sure that battery area is well ventilated and that bilge blower is in operation when charging. Do not smoke or allow sources of spark or open flame in area when charging battery.

⚠WARNING
Battery electrolyte is a corrosive acid and should be handled with extreme care. If electrolyte is spilled or splashed on any part of the body, immediately flush the exposed area with liberal amounts of water and obtain medical aid as soon as possible. Safety glasses and rubber gloves are recommended when handling batteries.

⚠CAUTION
To prevent damage to the electrical system be sure to adhere to the following:

a. **When installing battery, be sure to connect the (-) negative (grounded) battery cable to the (-) negative battery terminal and (+) positive battery cable to (+) positive battery terminal.**

b. **Never disconnect the battery cables while the engine is running.**

c. **If a charger or booster is to be used, be sure to connect it in parallel with existing battery (positive to positive and negative to negative).**

d. **When applying a booster charge to battery, disconnect both cables from battery (to prevent damage to voltage regulator).**

e. **Check battery condition periodically.**

f. **Make sure that battery leads are kept clean and tight.**

Testing

Place battery under heavy load (as during engine cranking or with a variable resistor tester) and test cell voltage while under load.

Certain conditions must be met before testing.

a. Battery must be between 60° and 100°.

b. Electrolyte level must be correct in all cells.

c. Battery must be at least half charged.

d. No obvious defects.

1. Check voltage per manufacturer's specifications.
2. If readings are low, recharge and retest.
3. If readings remain low, battery should be replaced.

⚠CAUTION
Test battery in well ventilated area as gases given off by battery are hazardous.

Storage

a. Remove battery and clean exterior.

b. Check fluid level and fill if low.

c. Cover terminals and bolts with light coat of grease.

d. Set battery on wood or in carton, store in cool, dry place.

e. Check every 20 days for fluid level and slow charge.

IMPORTANT: A discharged battery can be damaged by freezing.

Delco-Remy Starter Motor Specifications

DELCO IDENTIFICATION NUMBER	ENGINE ROTATION	NO LOAD TEST					BRUSH SPRING TENSION OZ. (GRAMS)
		VOLTS	MIN. AMPS	MAX. AMPS	MIN. RPM	MAX. RPM	
10455602	L.H.	10.6	70	120	5400	10800	56 - 105 (1588 - 2976)
10455603	L.H.	10.6	70	120	5400	10800	56 - 105 (1588 - 2976)
1998570	L.H.	10.6	70	120	5400	10800	56 - 105 (1588 - 2976)
10455601	R.H.	10.6	70	120	5400	10800	56 - 105 (1588 - 2976)
PINION CLEARANCE		.010 - .140 (.25 - 3.5mm)					
COMMUTATOR END FRAME GAP		.025 MAX. (.6mm MAX.)					

L.H. = LEFT HAND ENGINE ROTATION
R.H. = RIGHT HAND ENGINE ROTATION

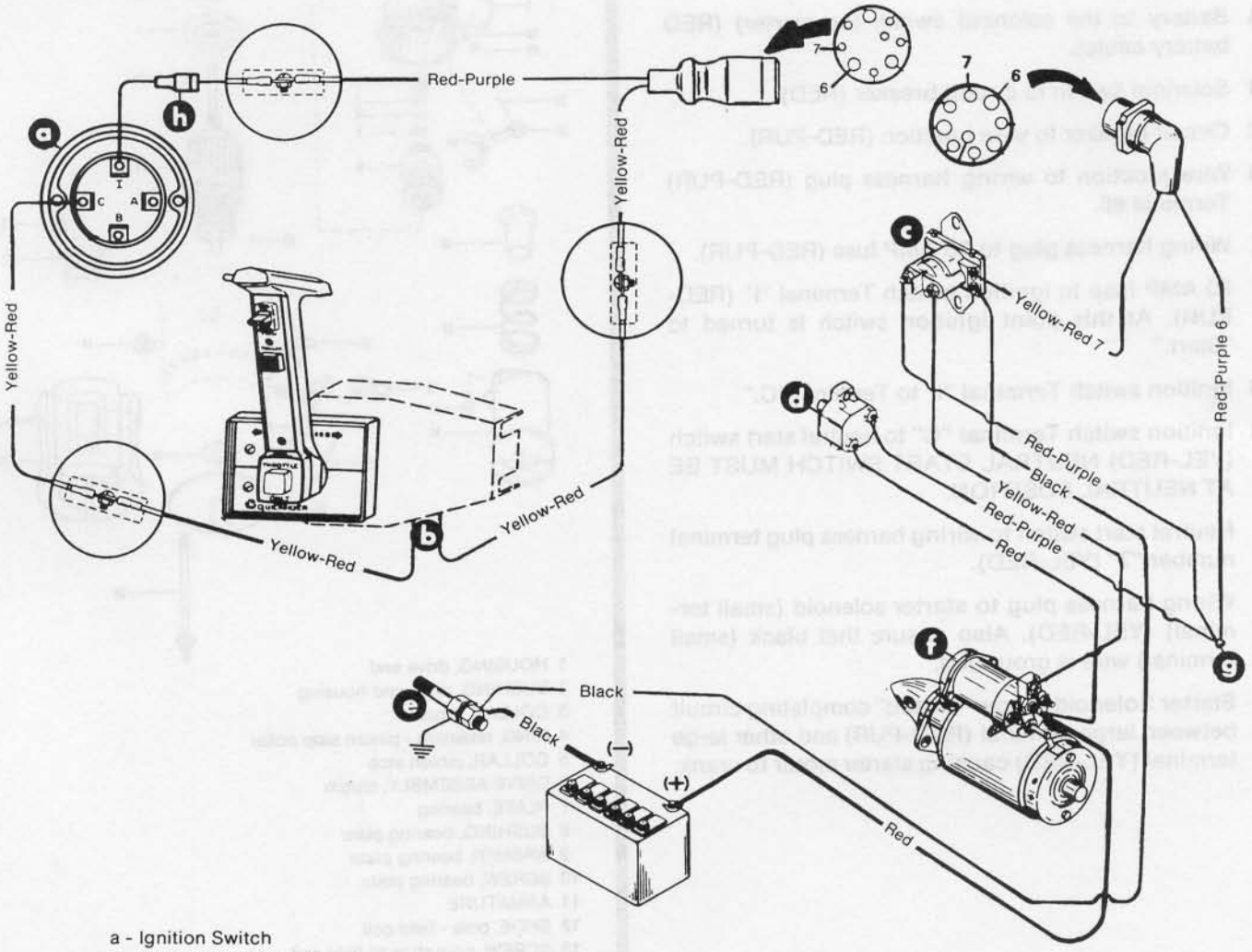
Torque Specifications

FASTENER LOCATION	LB. FT. (N·m)
Starter Motor to Block	50 (68)
Tighten All Other Fasteners Securely	

Lubricants - Sealants

92-25711 Liquid Neoprene
SAE 10W Oil
SAE 20W Oil

Starting System Components



a - Ignition Switch
b - Neutral Start Switch
c - Starter Slave Solenoid
d - Circuit Breaker
e - Engine Ground Stud
f - Starter Solenoid
g - Wire Junction
h - 20 Amp Fuse

Description

This is a general description of the positive current flow, from the battery and thru the system until the starter motor cranks.

A Battery to the solenoid switch (on starter) (RED battery cable).

B Solenoid switch to circuit breaker (RED).

C Circuit breaker to wire junction (RED-PUR).

D Wire junction to wiring harness plug (RED-PUR) Terminal #6.

E Wiring harness plug to 20 AMP fuse (RED-PUR).

F 20 AMP fuse to ignition switch Terminal "I" (RED-PUR). At this point ignition switch is turned to "Start."

G Ignition switch Terminal "I" to Terminal "C."

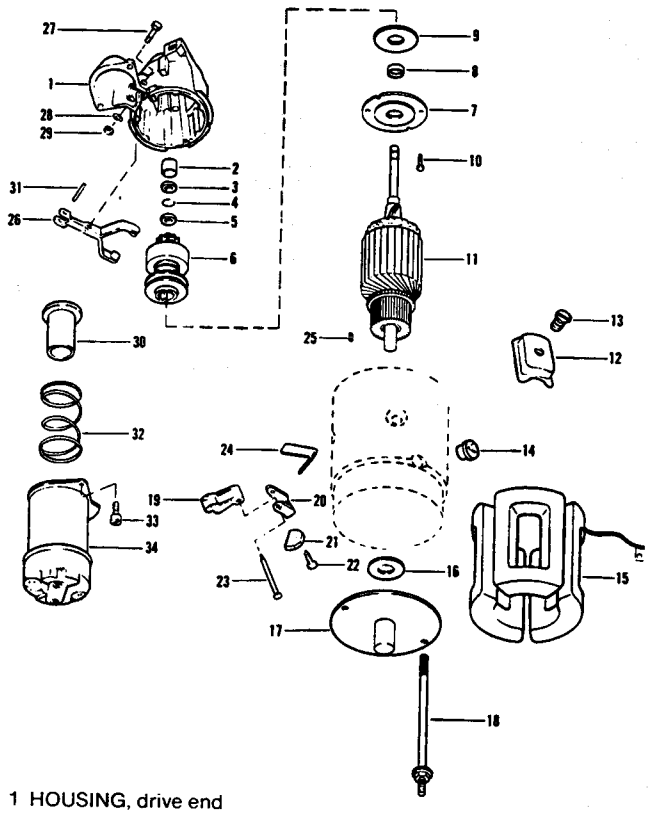
H Ignition switch Terminal "C" to neutral start switch (YEL-RED) NEUTRAL START SWITCH MUST BE AT NEUTRAL POSITION.

I Neutral start switch to wiring harness plug terminal number "7" (YEL-RED).

J Wiring harness plug to starter solenoid (small terminal) (YEL-RED). Also ensure that black (small terminal) wire is grounded.

K Starter Solenoid is now "closed" completing circuit between large terminal (RED-PUR) and other large terminal (YEL-RED) causing starter motor to crank.

Starter Motor Assembly



1 HOUSING, drive end
2 BUSHING, drive end housing
3 COLLAR, thrust
4 RING, retaining - pinion stop collar
5 COLLAR, pinion stop
6 DRIVE ASSEMBLY, clutch
7 PLATE, bearing
8 BUSHING, bearing plate
9 WASHER, bearing plate
10 SCREW, bearing plate
11 ARMATURE
12 SHOE, pole - field coil
13 SCREW, pole shoe to field coil
14 GROMMET, field coil - field frame
15 FIELD COIL ASSEMBLY
16 WASHER, leather - commutator end frame
17 FRAME, commutator end - lower
18 BOLT, thru
19 HOLDER, insulated - field frame brush
20 HOLDER, field frame brush ground
21 BRUSH, field frame
22 SCREW, brush lead
23 SUPPORT PACKAGE, ground and insulated holders
24 SPRING, field frame brush
25 PIN, dowel - field frame
26 LEVER, shift
27 STUD, shift lever
28 WASHER, shift lever stud
29 NUT, shift lever stud
30 PLUNGER, shift lever
31 PIN, plunger to shift lever
32 SPRING, plunger return
33 SCREW, solenoid switch
34 SOLENOID SWITCH ASSEMBLY

Periodic Inspection

Cranking motor and solenoid are completely enclosed in the drive housing to prevent entrance of moisture and dirt. However, periodic inspection is required:

a. Inspect terminals for corrosion and loose connections.

b. Inspect wiring for frayed and worn insulation.

c. Check mounting bolts for tightness.

Repair

Removal

⚠WARNING

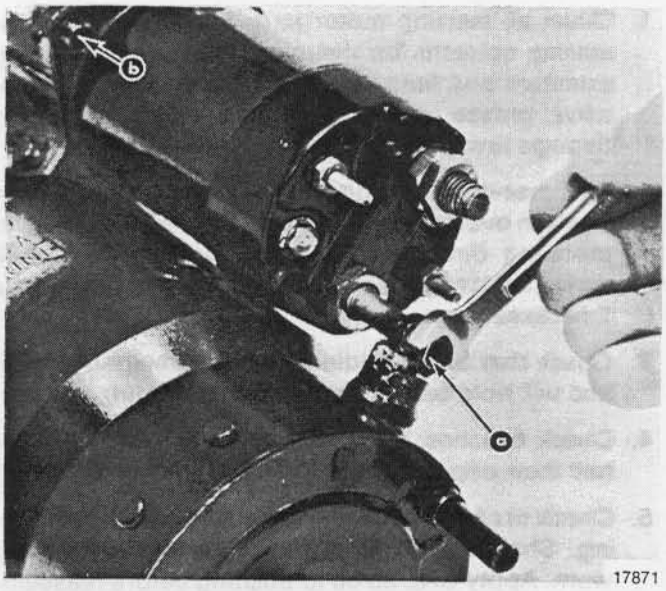
Disconnect battery cables at battery before removing starter.

1. Disconnect battery cables from battery.
2. Disconnect wires from solenoid terminals.
3. Remove starter mounting bolts.
4. Pull starter assembly away from flywheel and remove from engine.

Solenoid Switch

REMOVAL

1. Remove starter motor as outlined.
2. Remove screw from field coil connector and solenoid attaching screws.
3. Twist solenoid to disengage tab, and remove.



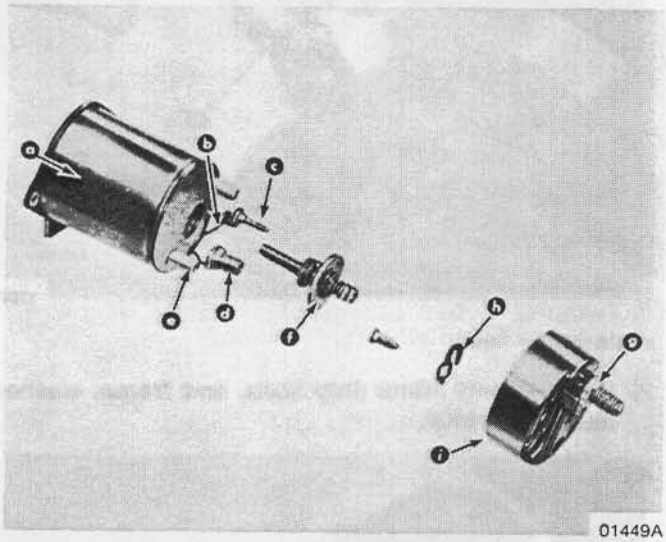
17871

a - Field Coil Screw
b - Attaching Screws

REPLACEMENT of CONTACTS

1. With solenoid removed from motor, remove nuts and washers from switch ("S") terminal and starter motor connector strap terminal.
2. Remove solenoid end cover retaining screws and washers and remove end cover from solenoid body.
3. Remove nut and washer from battery terminal on end cover and remove battery terminal.

IMPORTANT: DO NOT cut starter motor connector strap terminal wire to remove terminal, or wire will be too short.



01449A

a - Solenoid Body
b - To Hold in Coil
c - Switch Terminal
d - Motor Connector Strap Terminal
e - To Pull in Coil
f - Contact Ring and Push Rod Assembly
g - Battery Terminal
h - Contact Finger
i - End Cover

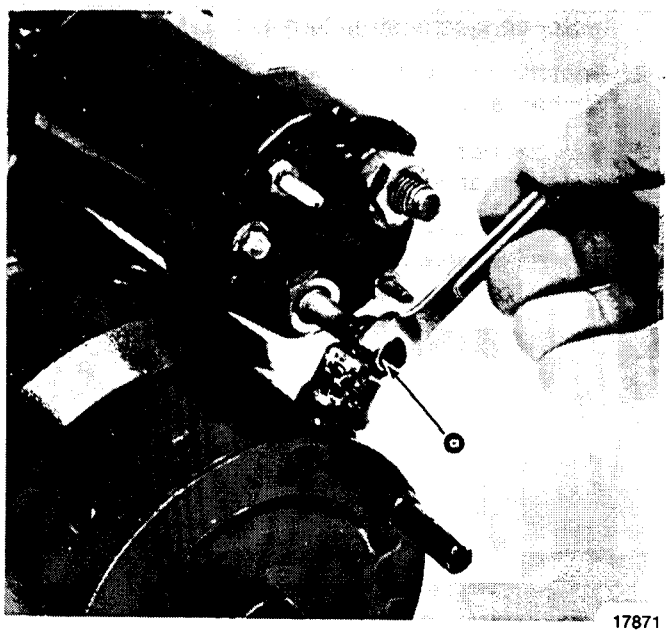
4. Remove motor connector strap terminal and solder new terminal in position.
5. Remove and install new battery terminal, washer and retaining nut to end cover.
6. Place new contact ring and push rod assembly in solenoid housing.
7. Position end cover over switch and motor terminals and install end cover retaining screws. Also install washers and nuts on solenoid switch and starting motor terminals.

INSTALLATION

1. Install solenoid onto plunger.
2. Twist solenoid to engage tab.
3. Install screws and tighten securely.
4. Install field coil connector screw.

Starter Motor Disassembly

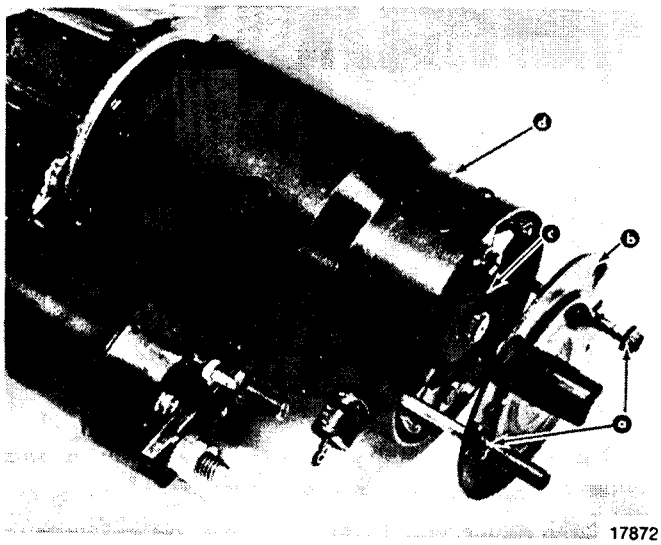
1. Remove screw from field coil connector.



17871

a - Connector Screw

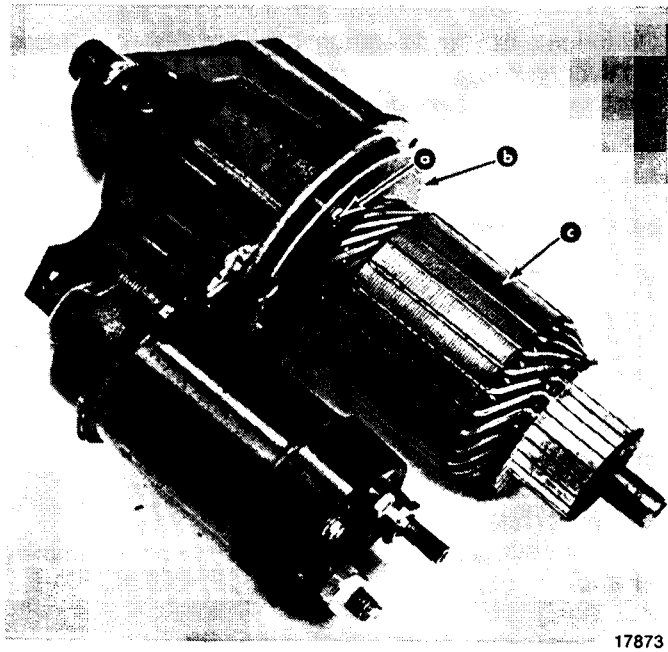
2. Remove end frame thru bolts, end frame, washer and field frame.



17872

a - Thru Bolts
b - End Frame
c - Washer
d - Field Frame

3. Remove screws, center bearing plate and armature.



17873

a - Screws
b - Bearing Plate
c - Armature

4. Slide thrust collar off armature shaft.
5. Drive retainer ring toward armature.
6. Remove snap ring, retainer and clutch assembly.

Cleaning and Inspection

With starting motor completely disassembled, except for removal of field coils, component parts should be cleaned and inspected. Field coils should be removed only where defects are indicated by tests. Defective parts should be replaced or repaired.

1. Clean all starting motor parts but do not use dissolving solvents for cleaning over-running clutch, armature and field coils. Such a solvent would dissolve grease packed in clutch mechanism and damage armature and field coil insulation.
2. Test over-running clutch action. Pinion should turn freely in over-running direction and must not slip in cranking direction. Check pinion teeth. Check spring for tension and drive collar for wear. Replace if necessary.
3. Check that brush holders are not damaged or bent and will hold brushes against commutator.
4. Check brushes. Replace if pitted or worn to one-half their original length [5/16 in. (8mm) or less].
5. Check fit of armature shaft in bushing of drive housing. Shaft should fit snugly. Replace bushing, if worn. Apply SAE 20 oil to bushing before reassembly. Avoid excessive lubrication.

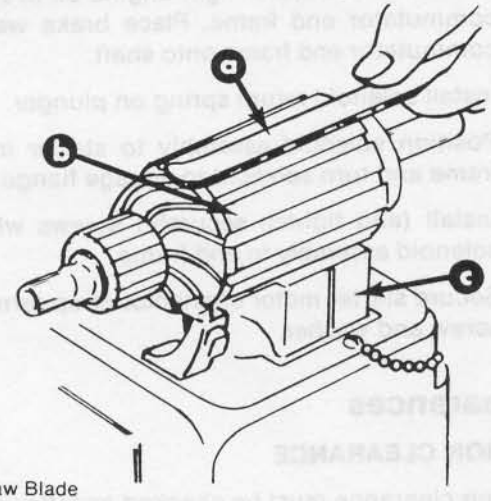
6. Check fit of bushing in commutator end frame. If bushing is damaged or worn excessively, replace end frame assembly. Apply SAE 20 oil to bushing before reassembly. Avoid excessive lubrication.

7. Inspect armature commutator. If rough or out-of-round, turn down and undercut. Inspect points (where armature conductors join commutator bars) for good, firm connection. Burned commutator bar usually is evidence of poor connection.

Armature Tests

TEST for SHORTS

Check armature for shorts by placing on growler and holding hack saw blade over armature core while rotating armature. If saw blade vibrates, armature is shorted. After cleaning between commutator bars, recheck. If saw blade still vibrates, replace armature.



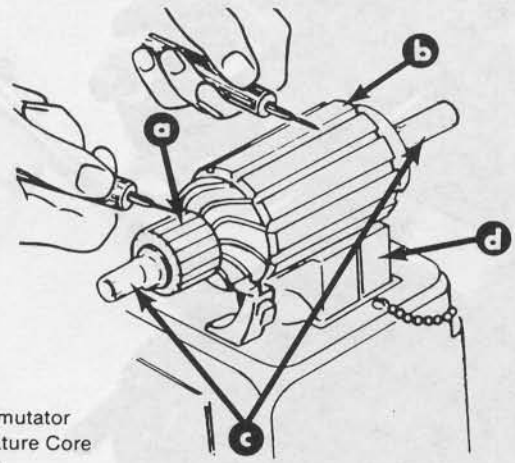
01440

a - Hacksaw Blade
b - Armature Core
c - Growler

TEST for GROUND

1. With continuity meter, place one lead on armature core or shaft and other lead on commutator.

2. If meter hand moves armature is grounded and must be replaced.



01441

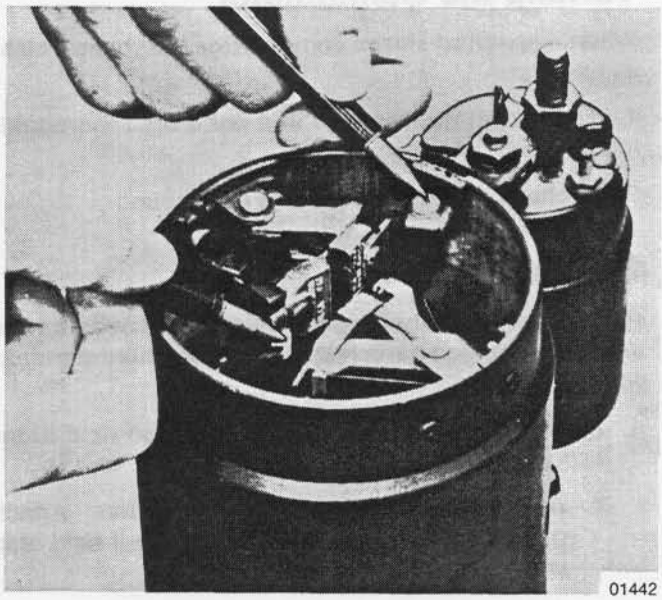
a - Commutator
b - Armature Core
c - Shaft
d - Growler

Field Coil Tests

TEST for OPEN CIRCUIT

1. With continuity meter, place one lead on each end of field coils (insulated brush and field connector bar).

2. If meter does not move, field coils are open and must be replaced.



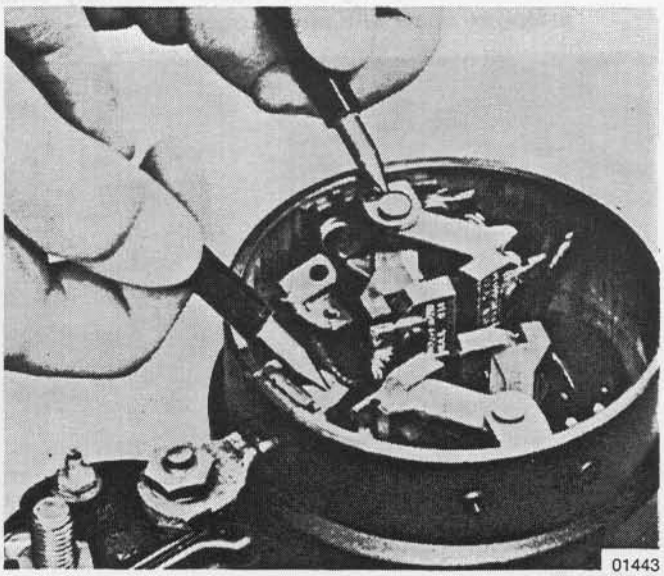
01442

TEST for GROUND

IMPORTANT: Be sure that positive brushes and leads do not contact field frame assembly during test, or false reading will result.

1. With continuity meter, place one lead on field connector bar and other lead on grounded brush.

2. If meter moves, field coils are grounded and must be replaced.



01443

Loose Electrical Connections

If open soldered connection of armature to commutator leads is found during inspection, resolder with rosin flux.

IMPORTANT: NEVER USE ACID FLUX ON ELECTRICAL CONNECTIONS.

Turning the Commutator

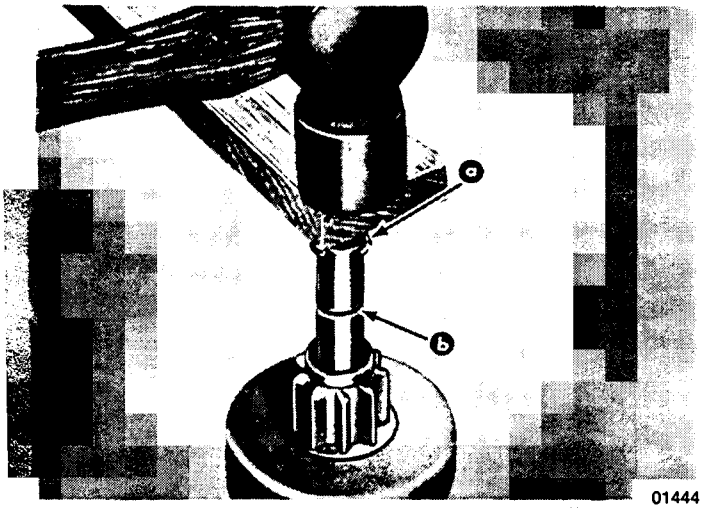
When inspection shows commutator roughness, clean as follows:

1. Turn down commutator in a lathe until thoroughly cleaned.
2. Recheck armature for shorts as outlined.

Reassembly

After all parts are thoroughly tested and inspected and worn or damaged parts replaced, reassemble starter as follows:

1. Assemble brushes and related parts to field frame as follows:
   a. Assemble brushes to brush holders. Attach ground wire to grounded brush and field lead wire to insulated brush.
   b. Assemble insulated and grounded brush holders together with "V" spring. Position as a unit and install support pin. Push holders and spring to bottom of support and rotate spring to engage center of "V" spring in slot in support.
2. Assemble over-running clutch assembly to armature shaft as follows:
   a. Lubricate drive end of armature shaft with SAE 10 oil.
   b. Slide assist spring and clutch assembly onto armature shaft with pinion outward.



01444

a - Snap Ring
b - Groove

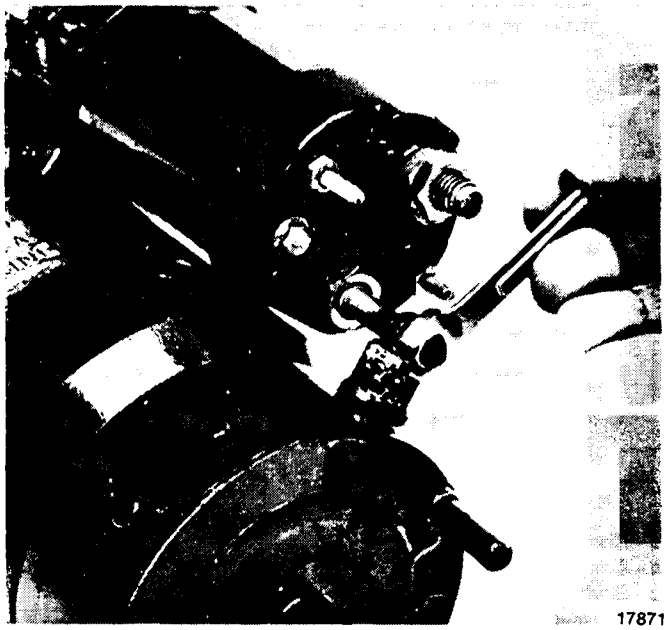
   c. Slide retainer onto shaft with cupped surface facing end of shaft (away from pinion).
   d. Drive snap ring onto shaft and slide down into groove.
   e. Assemble thrust collar on shaft with shoulder next to snap ring.
   f. Place thrust collar and retainer next to snap ring and using 2 pliers squeeze both until snap ring is forced into retainer.
3. Place 4 or 5 drops of light engine oil in drive housing bushing. Slide armature and clutch assembly into place while engaging shift lever with clutch.
4. Position field frame over armature and apply Liquid Neoprene between frame against drive housing, observing caution to prevent damage to brushes.
5. Place 4 to 5 drops of light engine oil in bushing in commutator end frame. Place brake washer and commutator end frame onto shaft.
6. Install solenoid return spring on plunger.
7. Position solenoid assembly to starter motor end frame and turn solenoid to engage flange in slot.
8. Install (and tighten securely) screws which hold solenoid assembly to end frame.
9. Secure starter motor connector strap terminal with screw and washer.

Clearances

PINION CLEARANCE

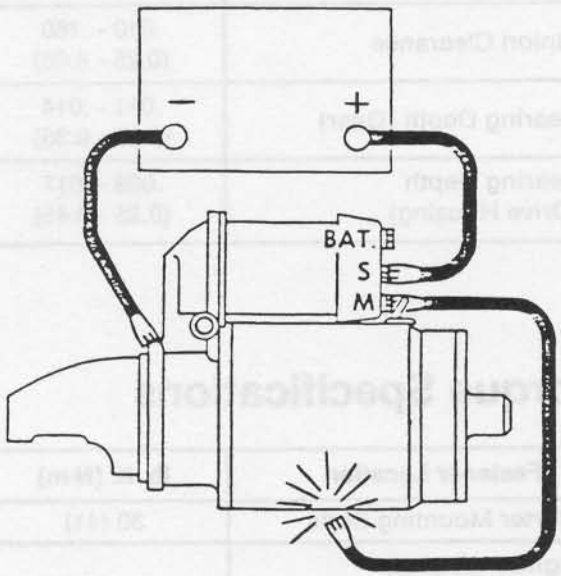
Pinion clearance must be checked as follows after reassembly of motor to insure proper adjustment.

1. Disconnect motor field coil connector from solenoid motor terminal and insulate it carefully.



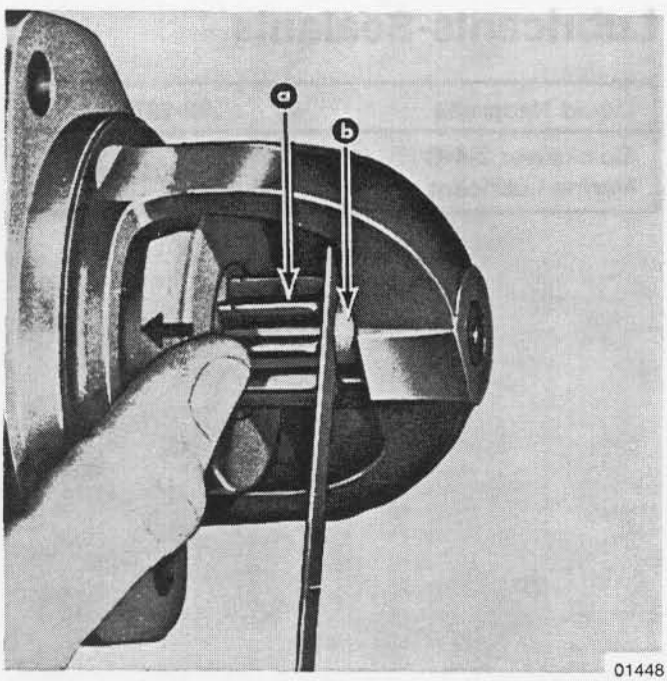
17871

2. Connect 12-volt battery from solenoid switch(s) terminal to solenoid frame.
3. Momentarily touch a jumper lead from solenoid motor terminal to starter motor frame. This shifts pinion into cranking position where it will remain until battery is disconnected.



01447

4. Push pinion back toward commutator end to eliminate slack.



01448

a - Pinion
b - Retainer

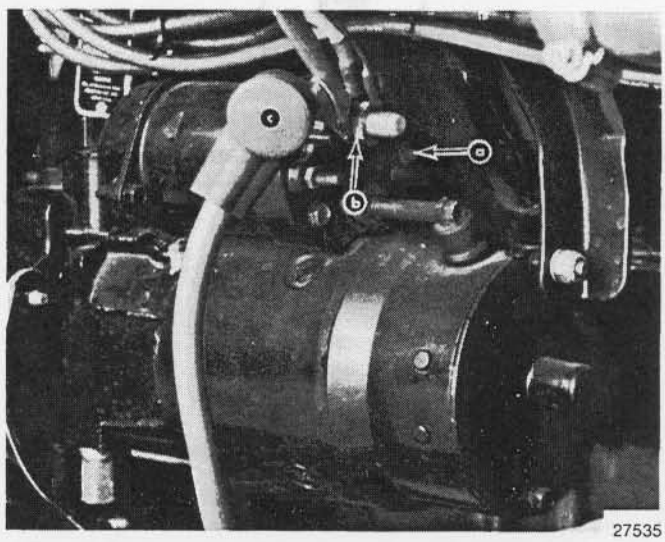
5. Measure distance between pinion and pinion retainer.
6. If clearance is not within specified limits, it may indicate excessive wear of solenoid linkage shift lever yoke buttons or improper assembly of shift lever mechanism. Check for proper assembly, and recheck gap. If still excessive, replace worn or defective parts, since no provision is made for adjusting pinion clearance.

COMMUTATOR END FRAME GAP

To keep the ignition-proof and safety requirement, the gap between the commutator end frame and field coil housing must be checked. See specifications. If the gap exceeds measurement when checked with a feeler gauge, the end frame should be checked for proper seating on the field coil housing. If properly seated and still found to have excessive gap, the end frame must be replaced.

Installation

1. Place starter motor and solenoid assembly in position and install mounting bolts. Torque bolts to 50 lb. ft. (68 N·m).
2. Fasten wires as outlined in wiring diagram.
3. Coat solenoid terminal connections with Liquid Neoprene.
4. Place rubber boot over positive battery cable connection.



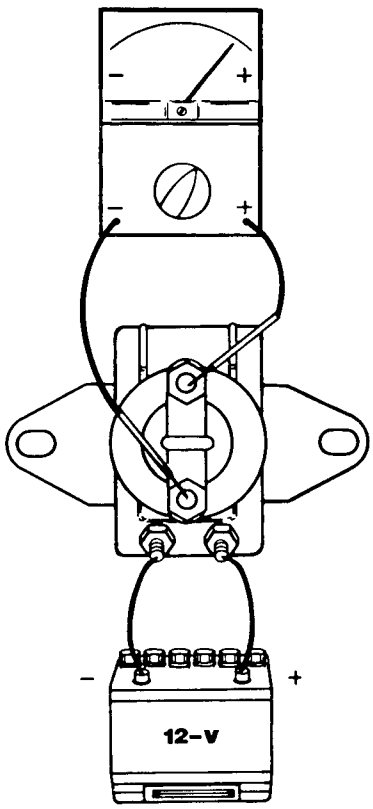
27535

a - Yellow-Red Wire
b - Red Wire and Positive Battery Cable
c - Rubber Boot

Standard Starter Slave Solenoid

Testing/Replacement

1. Using continuity meter, connect test leads as shown, and connect 12-volt battery with jumper leads as shown.



2. If no meter movement is present, replace solenoid.

Permanent Magnet Gear Reduction (PMGR) Starter Motor

Specifications	in. (mm)
Pinion Clearance	.010 - .160 (0.25 - 4.06)
Bearing Depth (Gear)	.011 - .014 (0.28 - 0.38)
Bearing Depth (Drive Housing)	.009 - .017 (0.25 - 0.45)

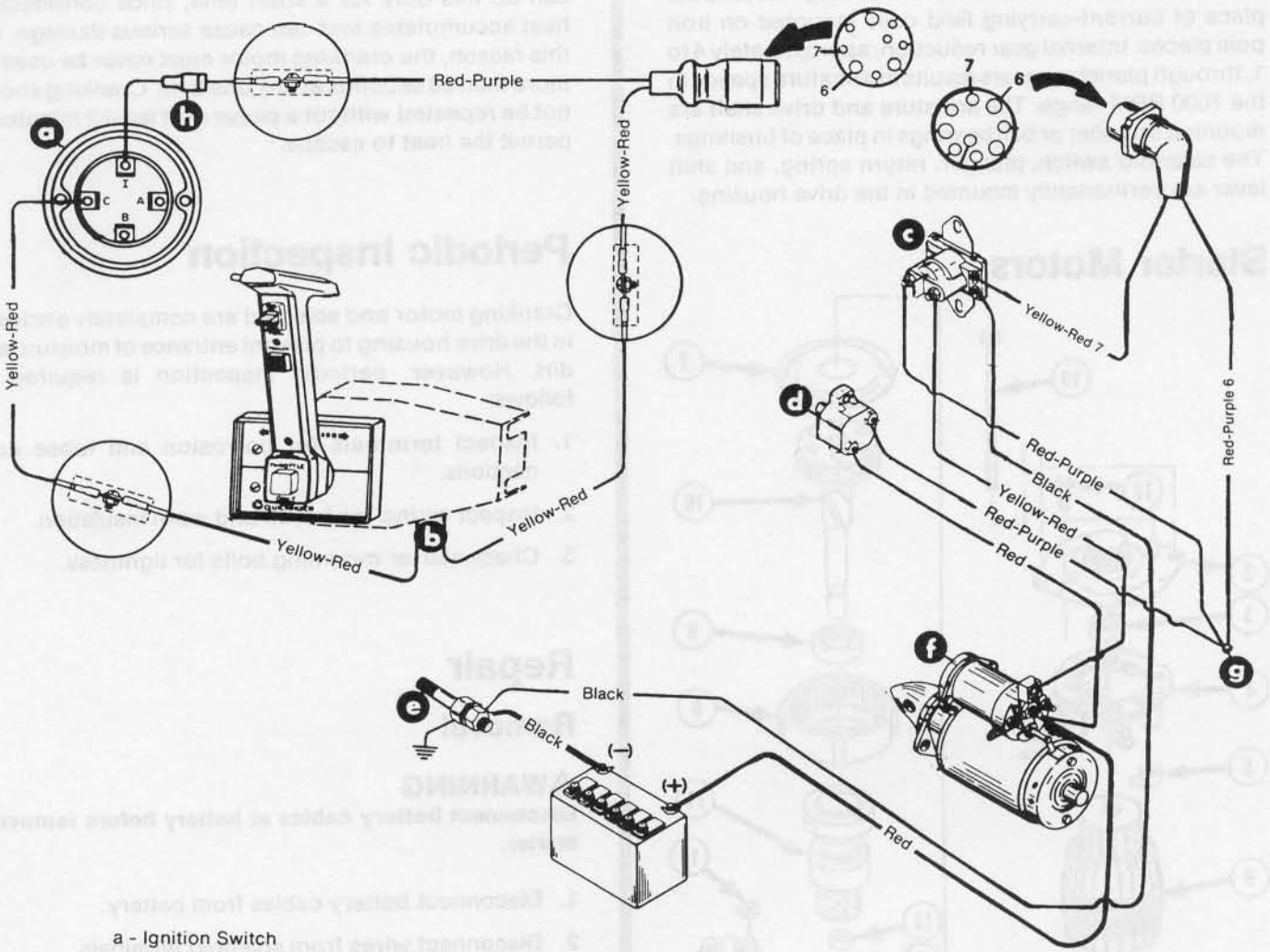
Torque Specifications

Fastener Location	lb. ft. (N·m)
Starter Mounting Bolts	30 (41)
Tighten all other fasteners securely	

Lubricants-Sealants

Liquid Neoprene	92-25711
Quicksilver 2-4-C Marine Lubricant	92-90018A12

Starting System Components

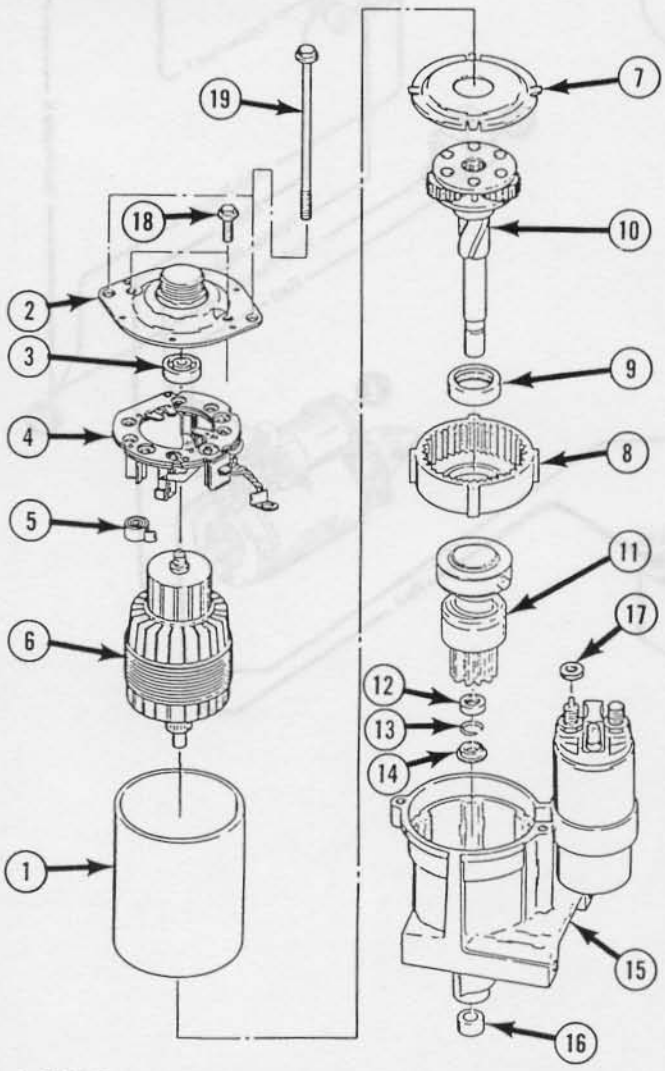


a - Ignition Switch
b - Neutral Start Switch
c - Starter Slave Solenoid
d - Circuit Breaker
e - Engine Ground Stud
f - Starter Solenoid
g - Wire Junction
h - 20 Amp Fuse

Description

The Permanent Magnet Gear Reduction (PMGR) starter motor features small permanent magnets mounted inside the field frame. These magnets take the place of current-carrying field coils mounted on iron pole pieces. Internal gear reduction, approximately 4 to 1, through planetary gears results in armature speeds in the 7000 RPM range. The armature and drive shaft are mounted on roller or ball bearings in place of bushings. The solenoid switch, plunger, return spring, and shift lever are permanently mounted in the drive housing.

Starter Motors



1 - Field Frame (With Permanent Magnets)
2 - End Frame
3 - Ball Bearing
4 - Brushes with Holder
5 - Brush Spring
6 - Armature
7 - Shield
8 - Gear
9 - Roller Bearing
10 - Planetary Gear and Shaft Assembly
11 - Drive
12 - Collar
13 - Retaining Ring
14 - Thrust Collar
15 - Drive Housing*
16 - Roller Bearing
17 - Nut
18 - Screw
19 - Thru Bolt

*Contains: Starter Solenoid, Plunger, Return Spring, and Shift Lever

Notice

The starter motor is designed to operate under great overload and produce a high horsepower for its size. It can do this only for a short time, since considerable heat accumulates and can cause serious damage. For this reason, the cranking motor must never be used for more than 30 seconds at any one time. Cranking should not be repeated without a pause of at least 2 minutes to permit the heat to escape.

Periodic Inspection

Cranking motor and solenoid are completely enclosed in the drive housing to prevent entrance of moisture and dirt. However, periodic inspection is required as follows:

1. Inspect terminals for corrosion and loose connections.
2. Inspect wiring for frayed and worn insulation.
3. Check starter mounting bolts for tightness.

Repair

Removal

⚠WARNING
Disconnect battery cables at battery before removing starter.

1. Disconnect battery cables from battery.
2. Disconnect wires from solenoid terminals.

IMPORTANT: Some starter motors may use a special mounting shim for gaining flywheel clearance. Do not lose this shim, it will be needed when remounting starter on engine block.

3. Remove starter mounting bolts.
4. Pull starter assembly away from flywheel and remove from engine.

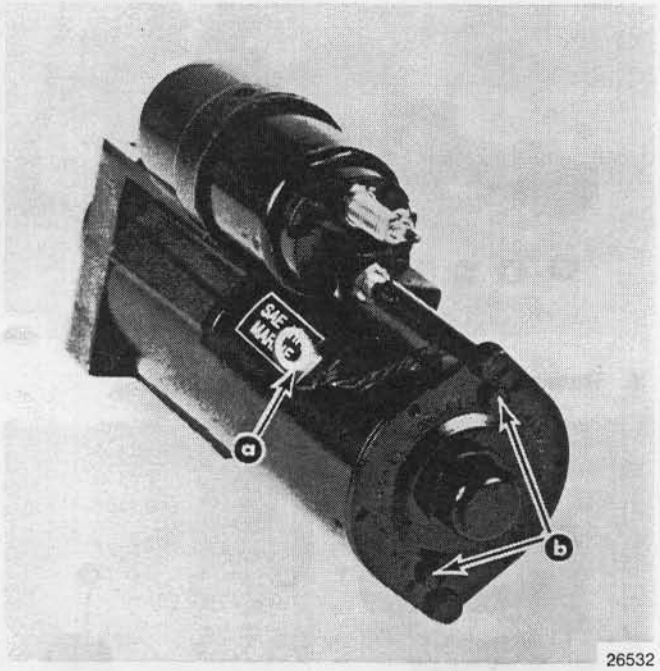
Solenoid Switch

The solenoid switch, along with plunger, return spring, and shift lever, are completely sealed and permanently mounted in the drive housing. If solenoid is defective, entire drive housing must be replaced.

Starter Motor

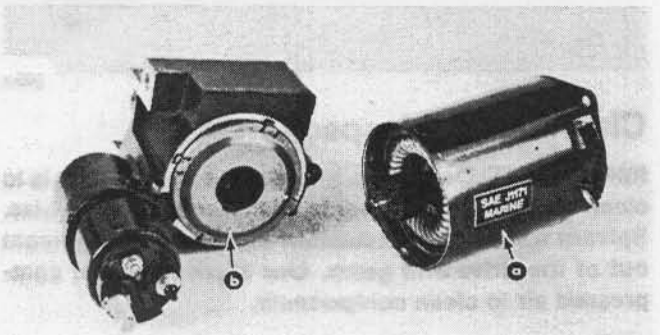
Disassembly

1. Remove brush lead (a) from solenoid and screws (b) from end frame.



26532

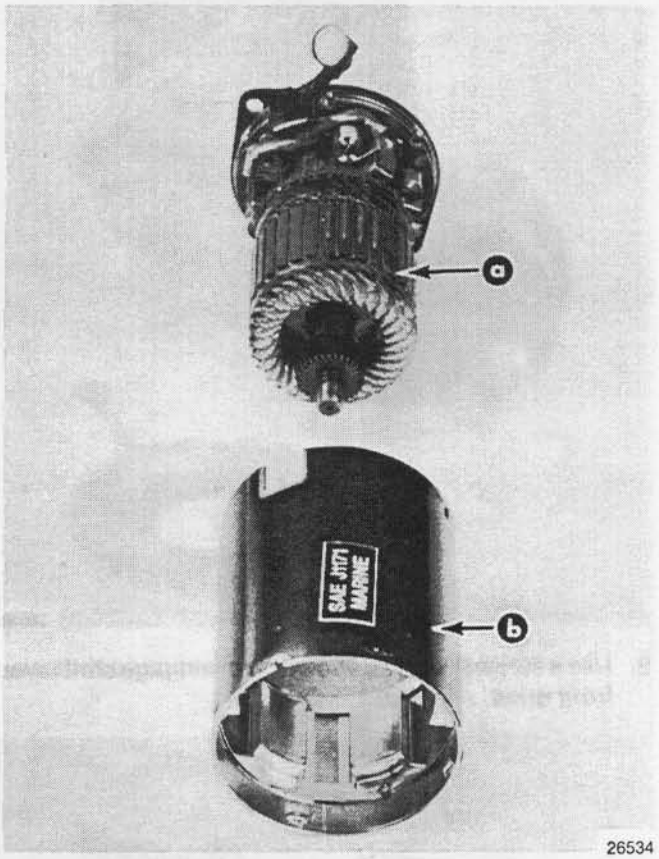
2. Remove thru bolts and separate field frame with armature (a) from drive housing (b).



26533

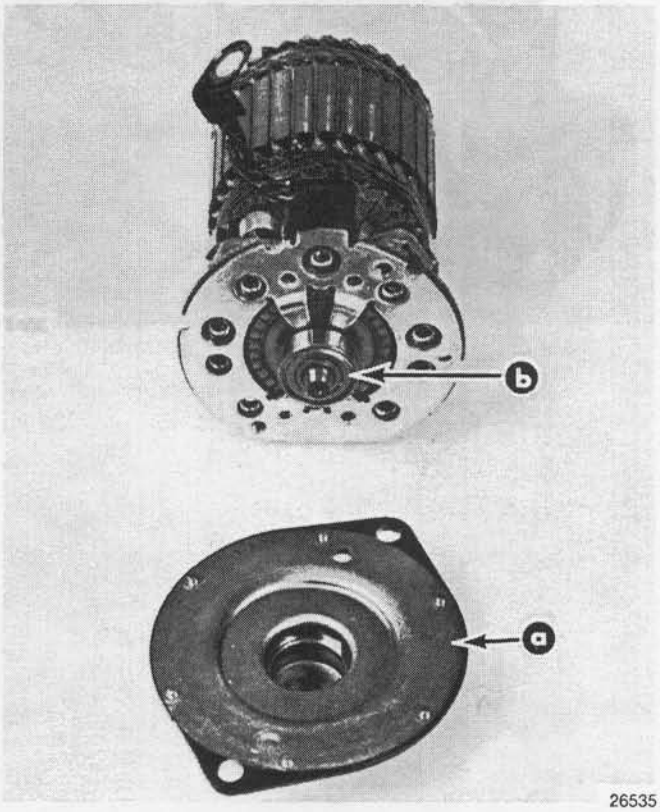
3. Pull armature (a) out of field frame (b).

NOTE: Permanent magnets inside field frame will be holding armature in place.



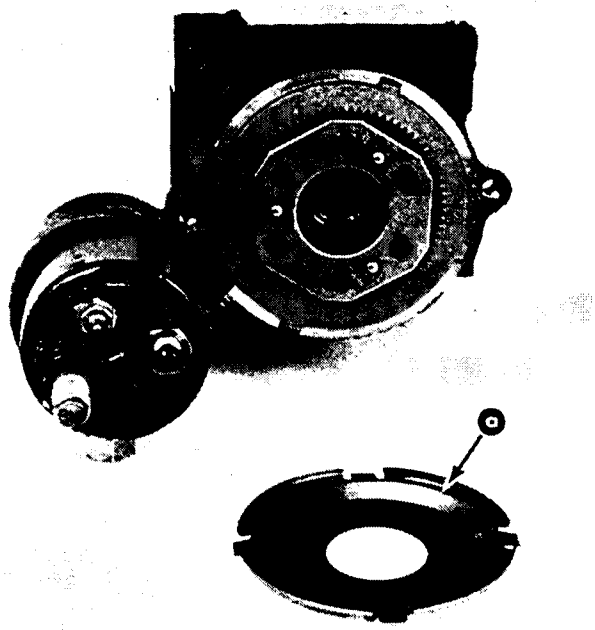
26534

4. Pull end frame (a) off bearing (b).



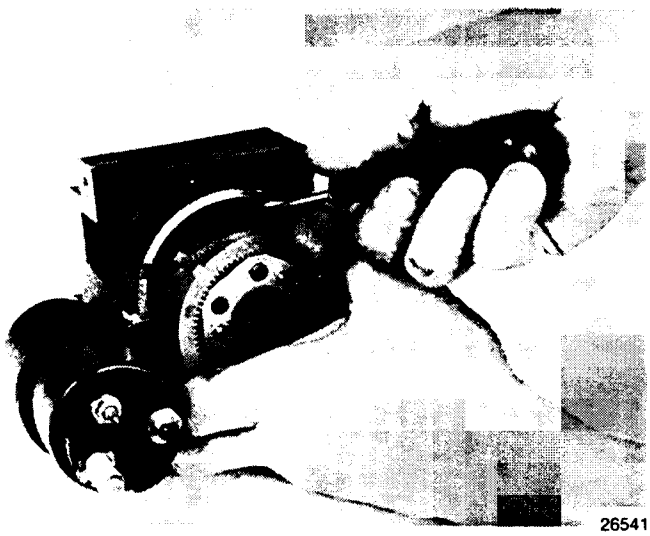
26535

5. Remove shield (a).

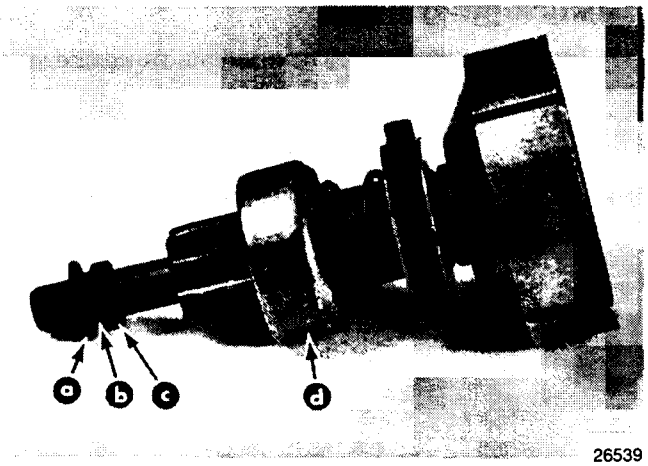


26536

6. Use a screwdriver, as shown, to disengage shift lever from drive.

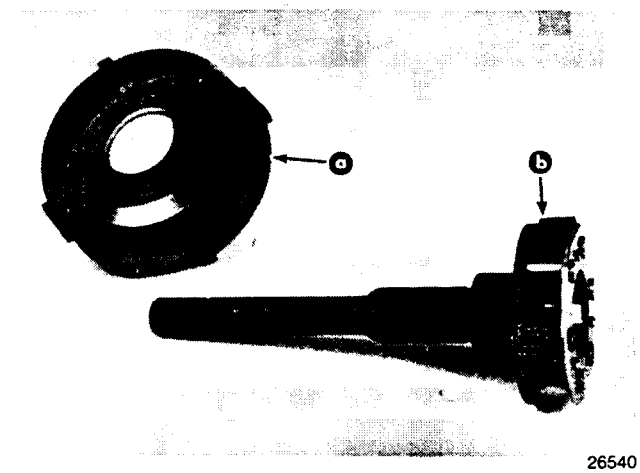

26541

7. Remove thrust collar (a), retaining ring (b) and collar (c). Remove drive (d).



26539

8. Remove gear (a) from shaft assembly (b).



26540

Cleaning and Inspection

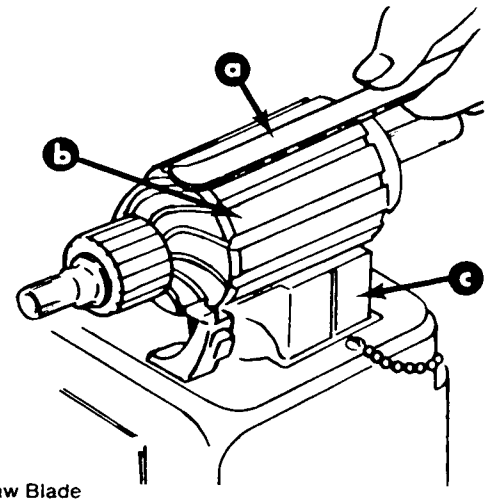
IMPORTANT: Do not use grease dissolving solvents to clean electrical components, planetary gears, or drive. Solvent will damage insulation and wash the lubricant out of the drive and gears. Use clean rags and compressed air to clean components.

1. Test over-running clutch action of drive. Pinion should turn freely in over-running direction and must not slip in cranking direction. Check pinion teeth. Check spring for tension and drive collar for wear. Replace if necessary.
2. Check that brush holders are not damaged or bent and hold brushes against commutator. Check brushes for wear; refer to "Brushes and Brush Holder."
3. Inspect armature commutator. If badly grooved or out-of-round, turn down and undercut commutator.
4. Inspect all roller bearing surfaces for wear. Check that bearings roll freely. If any roughness is felt, replace bearings.
5. Inspect planetary gear assembly. Gears must mesh easily and roll freely with no binding.

Armature Tests

TEST FOR SHORTS

Check armature for shorts by placing on growler and holding hack saw blade over armature core while rotating armature. If saw blade vibrates, armature is shorted. After cleaning between commutator bars, recheck. If saw blade still vibrates, replace armature.

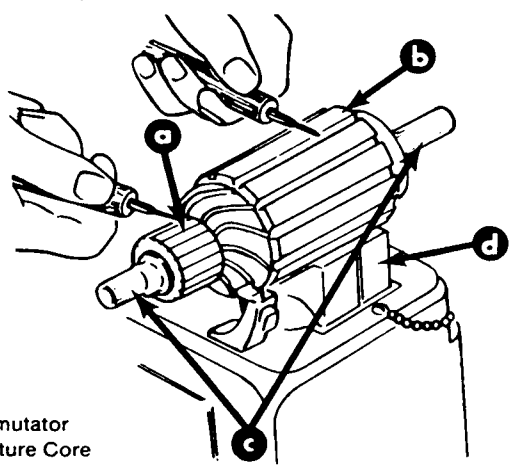


01440

a - Hacksaw Blade
b - Armature Core
c - Growler

TEST for GROUND

1. With continuity meter, place one lead on armature core or shaft and other lead on commutator.
2. If meter hand moves armature is grounded and must be replaced.



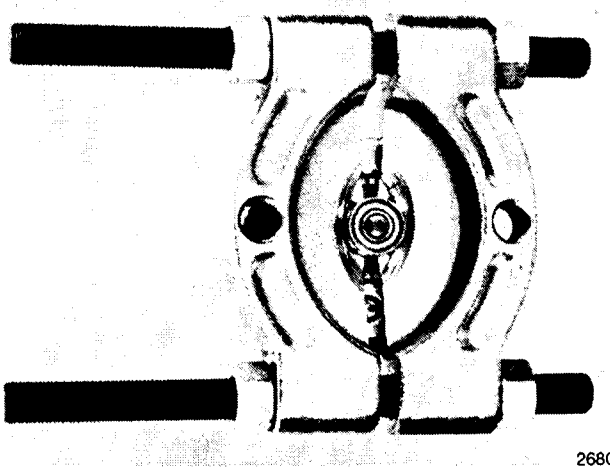
01441

a - Commutator
b - Armature Core
c - Shaft
d - Growler

Armature Bearing (Commutator End)

Removal

Use a universal puller plate, as shown, to remove bearing.



26804

Installation

IMPORTANT: Brush holder must be installed on armature before installing armature bearing.

Using the correct size driver, press on inner bearing race, until it contacts shoulder of armature shaft.

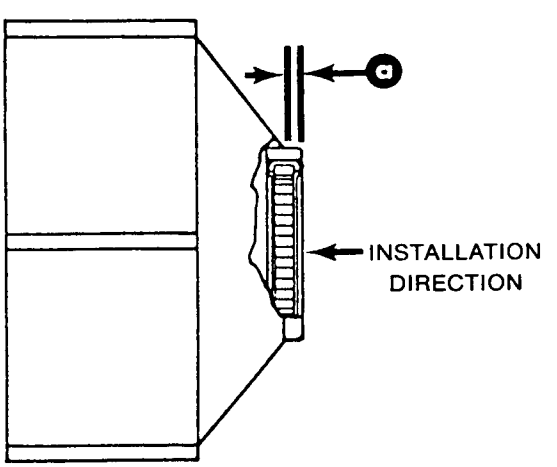
Gear Bearing

Removal

Using the correct size driver, press bearing out of gear.

Installation

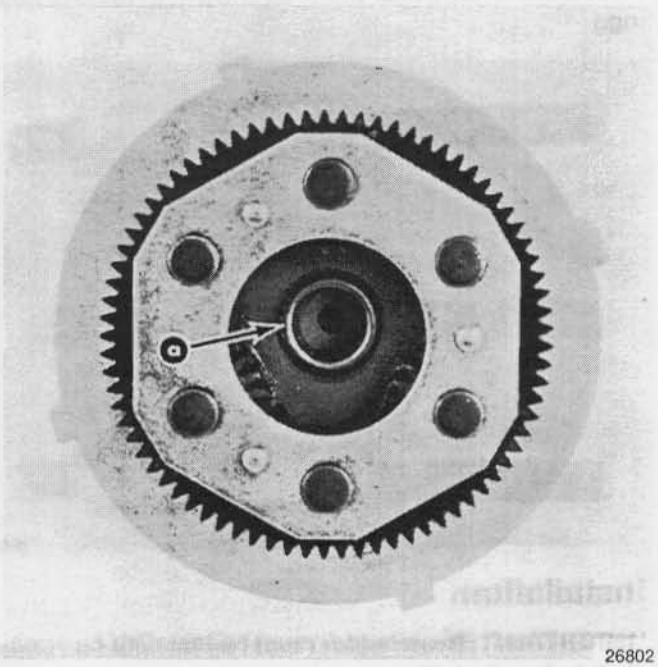
1. Using the correct size driver, press bearing into gear, from direction shown, to a depth of .011 - .014 in. (0.28 - 0.38mm), (a).



2. Lubricate bearing and gear teeth with a small amount of Quicksilver 2-4-C Marine Lubricant.

SHAFT ASSEMBLY BEARING

IMPORTANT: Roller bearing (a) is not replaceable. If bearing is defective, replace entire shaft assembly. Apply Quicksilver 2-4-C Marine Lubricant to bearing before starter reassembly.



26802

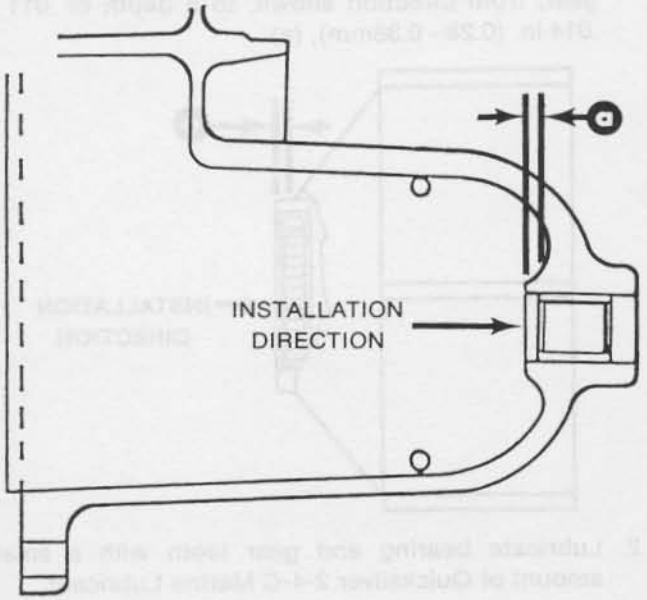
Drive End Housing Bearing

Removal

Using the correct size driver, press bearing out of housing.

Installation

1. Using the correct size driver, press bearing into housing, from direction shown, to a depth of .009 - .017 in. (0.25-0.45mm), (a).



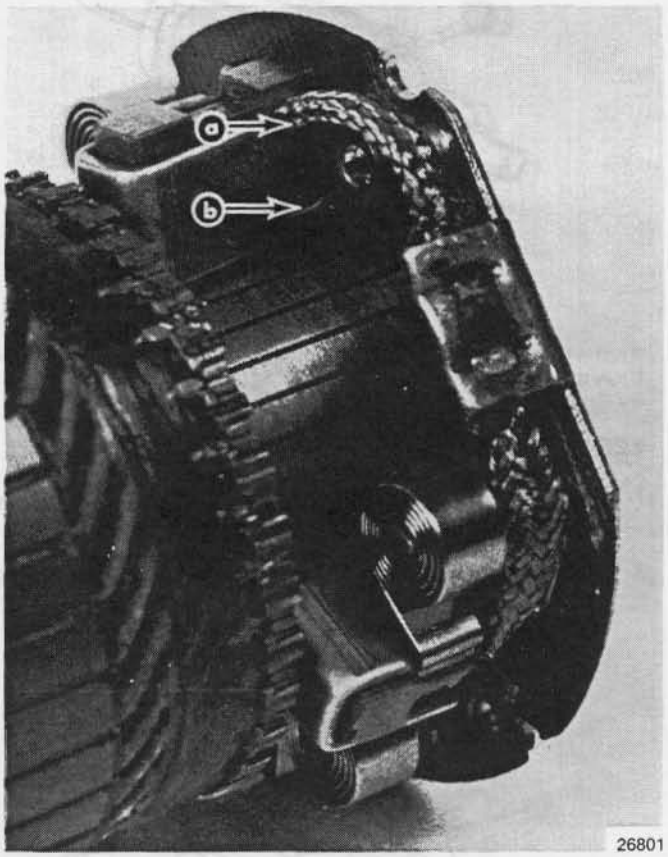
2. Lubricate bearing with a small amount of Quicksilver 2-4-C Marine Lubricant.

Brushes and Brush Holder

Inspection

Replace brushes and holder when brush leads (a) are touching guide (b).

Make sure brushes can move freely in guides.



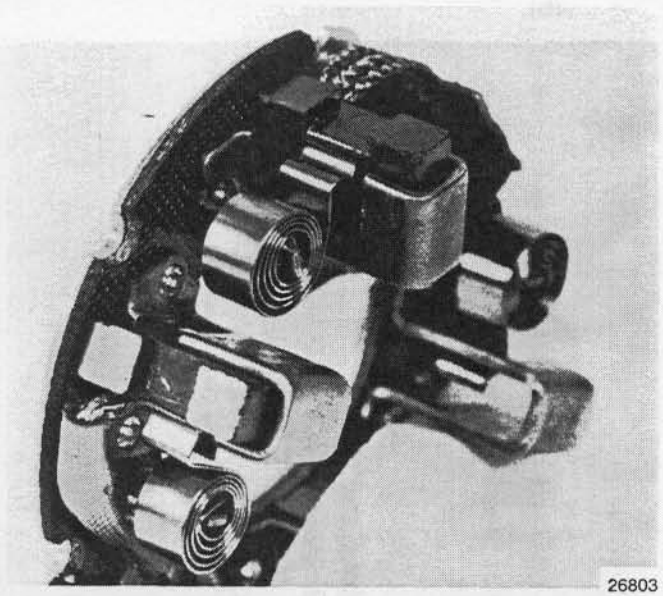
26801

Removal

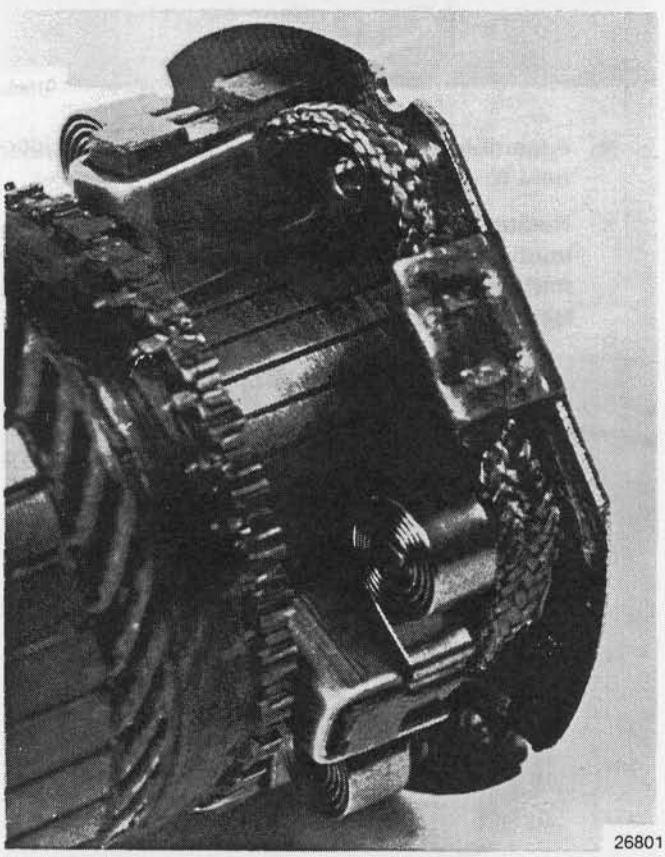
1. Remove armature bearing as previously described.
2. Remove brush holder.

Installation

1. Push each brush up into its guide to allow spring to hold it in place, as shown.


26803

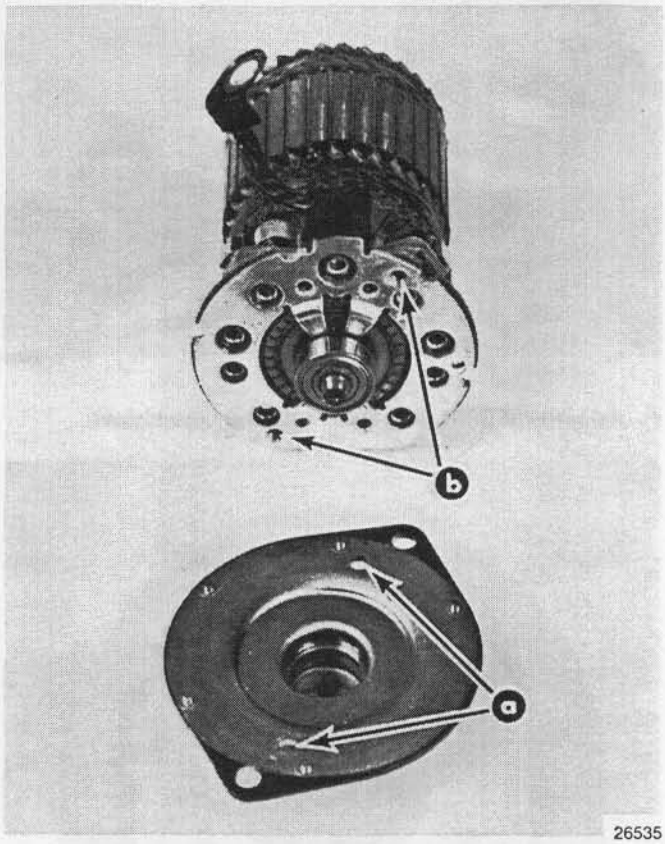
2. Place brush holder on armature and push brushes down against commutator, as shown.


26801

3. Install armature bearing as previously described.

Reassembly

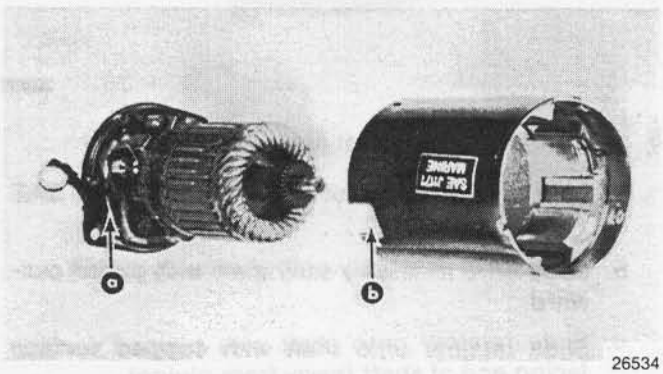
1. Install end frame on brush holder. Align holes (a) of end frame with holes (b) of brush holder. Tighten screws securely.



26535

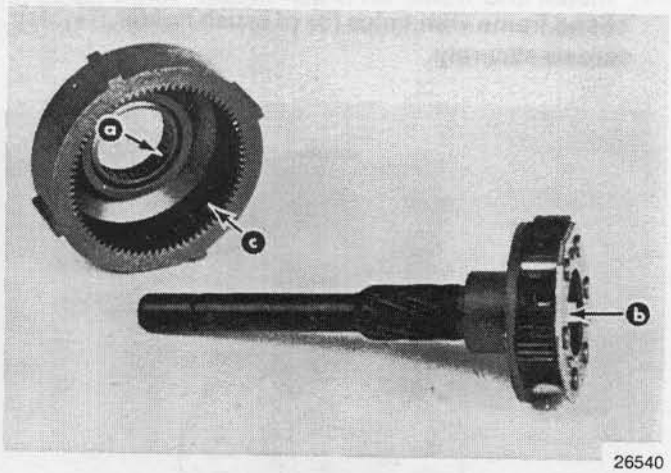
2. Insert armature into field frame. Align brush holder lead (a) with notch (b) in field frame.

NOTE: Permanent magnets in field frame will pull armature in place.



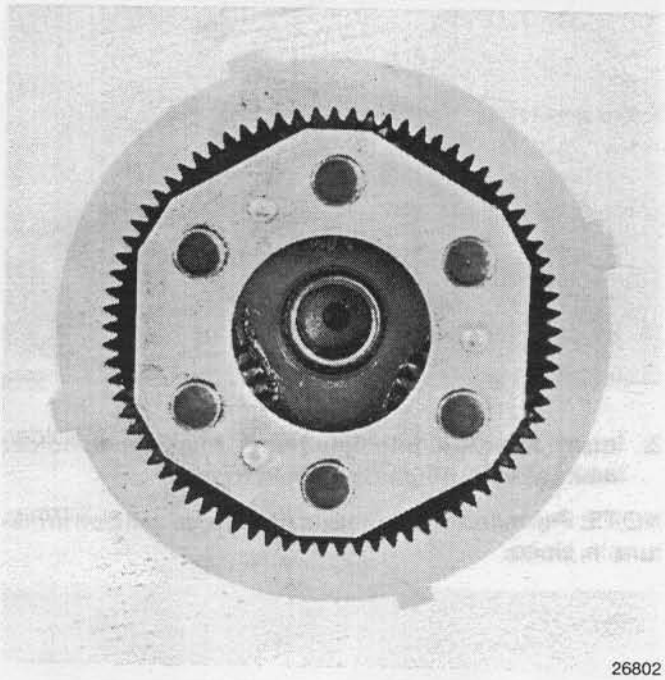
26534

3. Coat roller bearings (a) and (b), and gear (c) with a small amount of Quicksilver 2-4-C Marine Lubricant.

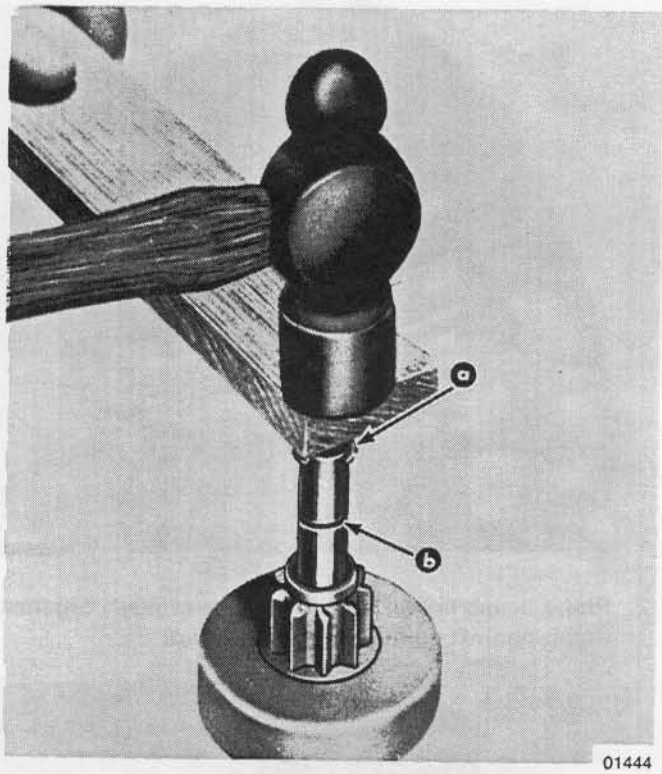


26540

4. Assemble gear and shaft together, as shown.

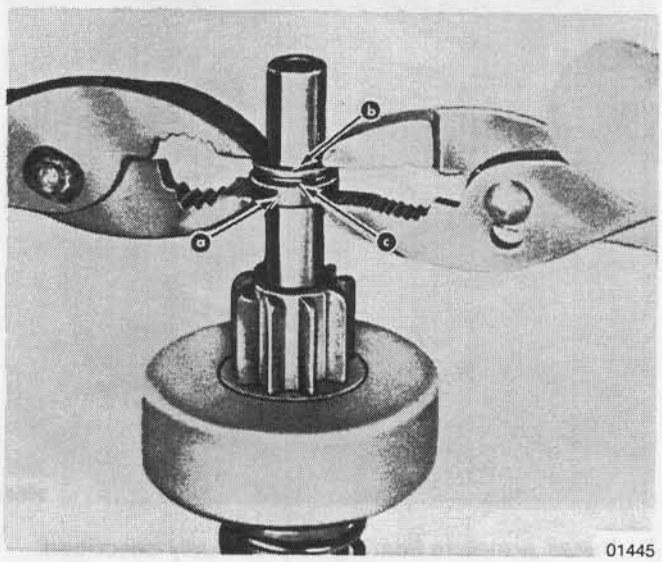

26802

5. Assemble drive on shaft assembly as follows:
   a. Lubricate drive end of shaft assembly with SAE 10W oil.
   b. Slide drive assembly onto shaft with pinion outward.
   c. Slide retainer onto shaft with cupped surface facing end of shaft (away from pinion).
   d. Position snap ring (a) on upper end of shaft and hold in place with block of wood. Strike wood block with hammer, thus forcing snap ring over end of shaft. Slide snap ring down into groove (b).



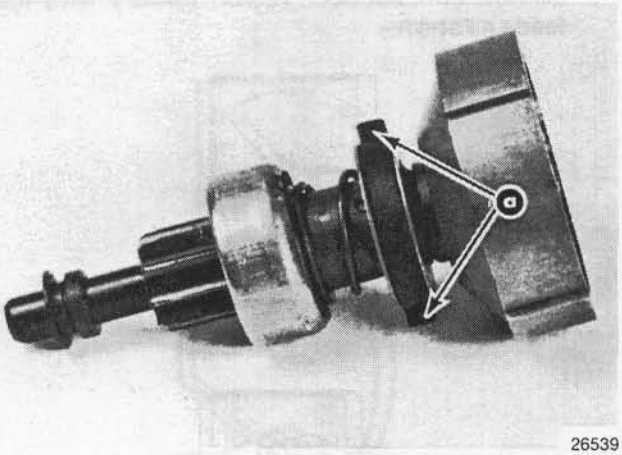
01444

   e. Assemble thrust collar on shaft with shoulder next to snap ring.
   f. Position retainer (a) and thrust collar (b) next to snap ring (c). Then, using 2 pliers, grip retainer and thrust collar and squeeze until snap ring is forced into retainer.

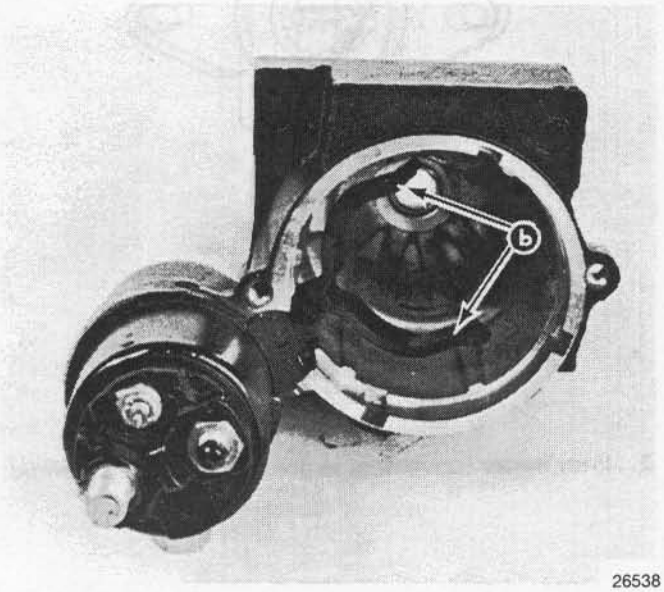


01445

6. Apply a thin coating of Quicksilver 2-4-C Marine Lubricant to roller bearing in drive housing.
7. Insert shaft and drive assembly into drive housing. Pins of drive (a) must be snapped into holes of shift lever (b). Thrust collar must be in place before shaft is inserted in housing roller bearing.

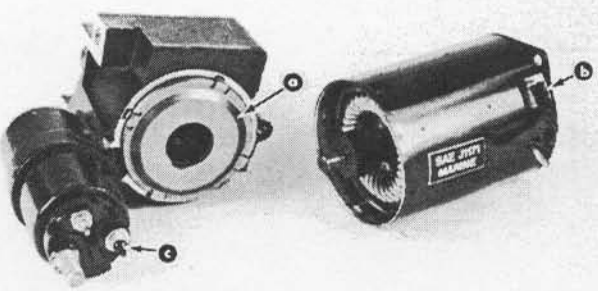


26539



26538

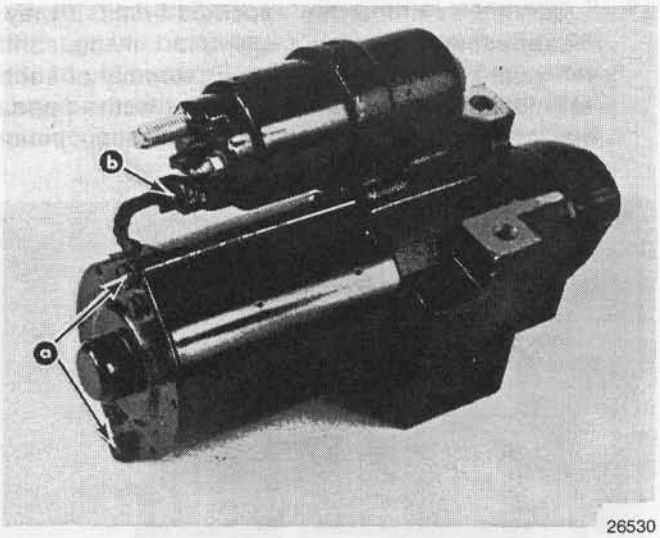
8. Install shield (a). Align brush lead (b) and solenoid terminal (c) when inserting armature into planetary gears.



26533

9. Install thru bolts (a) and brush lead (b). Tighten fasteners securely.

IMPORTANT: Do not overtighten thru bolts. Overtightening will bend end frame.



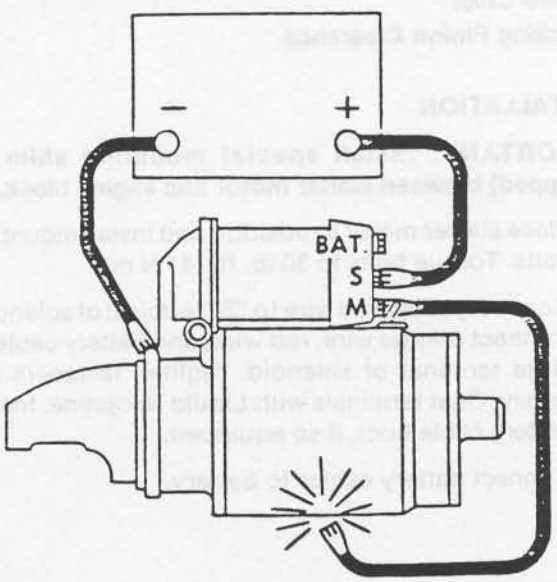
26530

Clearances

PINION CLEARANCE

Pinion clearance must be checked after reassembly of starter motor.

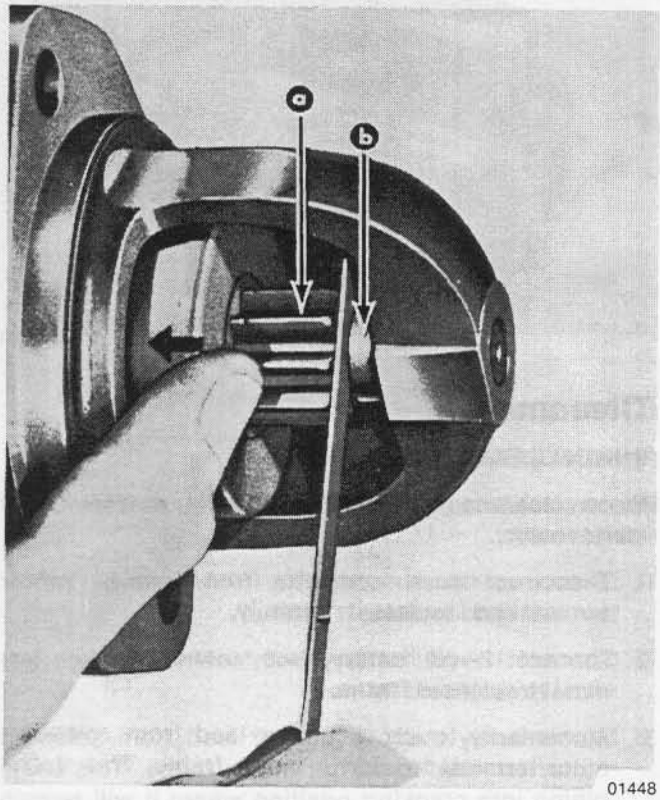
1. Disconnect brush connector from solenoid motor terminal and insulate it carefully.
2. Connect 12-volt battery from solenoid switch terminal to solenoid frame.
3. Momentarily touch a jumper lead from solenoid motor terminal to starter motor frame. This shifts pinion into cranking position where it will remain until battery is disconnected.



01447

Circuit for Checking Pinion Clearance

4. Push pinion back toward commutator end to eliminate slack.
5. Measure distance between pinion and pinion retainer.
6. If clearance is not within specified limits, it may indicate excessive wear of solenoid linkage, shift lever yoke buttons, or improper assembly of shift lever mechanism. Replace worn or defective parts, since no provision is made for adjusting pinion clearance.



01448

a - Pinion
b - Retainer
c - Feeler Gauge

Checking Pinion Clearance

INSTALLATION

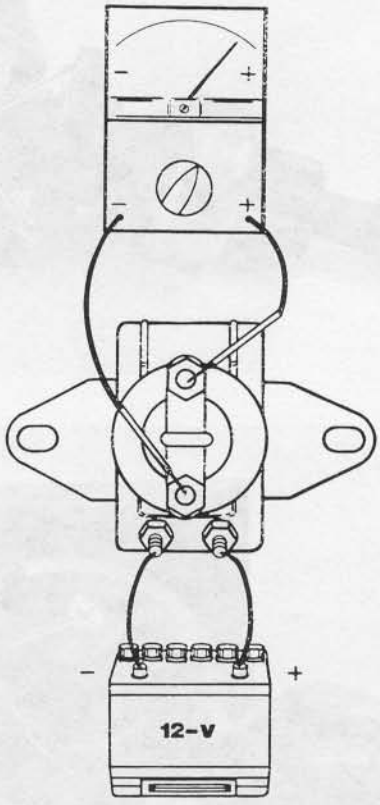
IMPORTANT: Install special mounting shim (if equipped) between starter motor and engine block.

1. Place starter motor in position and install mounting bolts. Torque bolts to 30 lb. ft. (41 N·m).
2. Connect yellow/red wire to "S" terminal of solenoid. Connect orange wire, red wire, and battery cable to large terminal of solenoid. Tighten fasteners securely. Coat terminals with Liquid Neoprene. Install battery cable boot, if so equipped.
3. Connect battery cables to battery.

Standard Starter Slave Solenoid

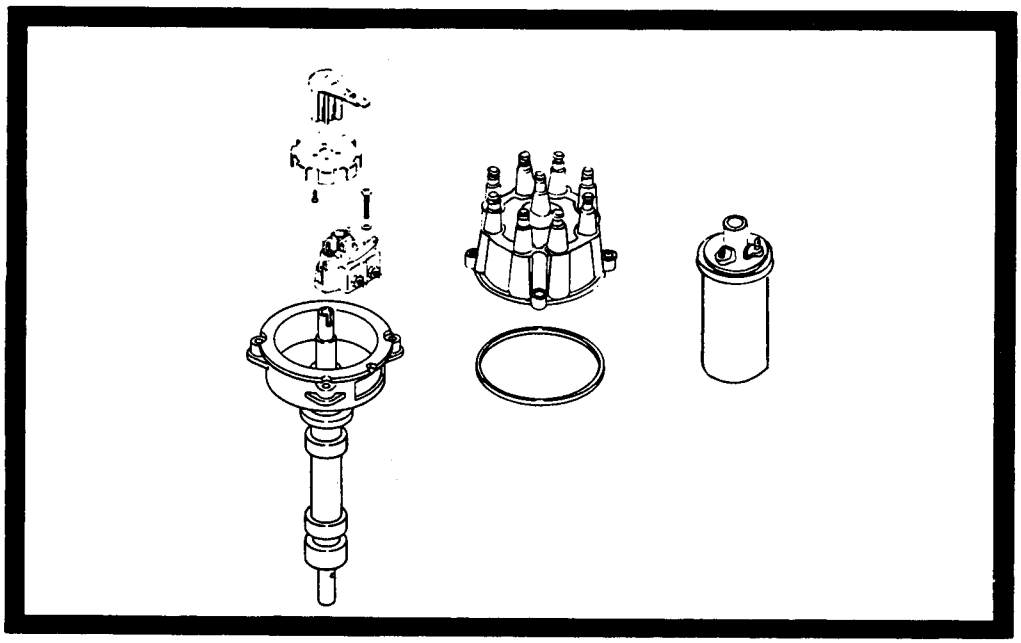
Testing/Replacement

1. Using continuity meter, connect test leads as shown, and connect 12-volt battery with jumper leads as shown.



2. If no meter movement is present, replace solenoid.

ELECTRICAL SYSTEM



4

B

IGNITION SYSTEM

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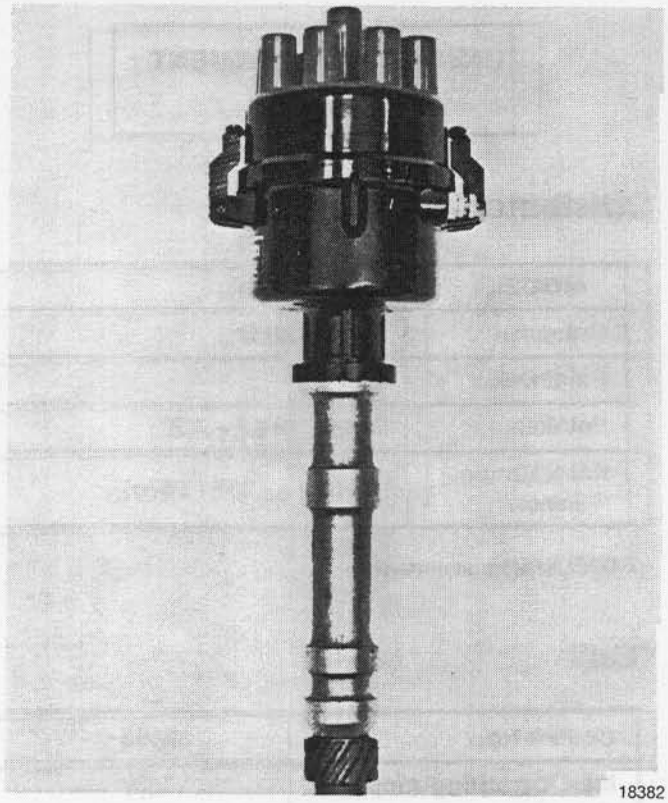
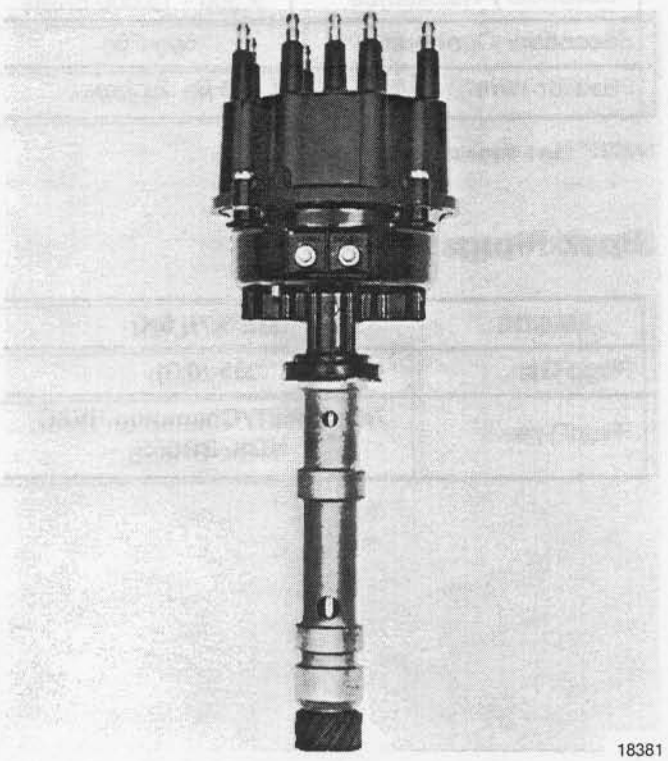
Identification



18382

Mallory Distributor



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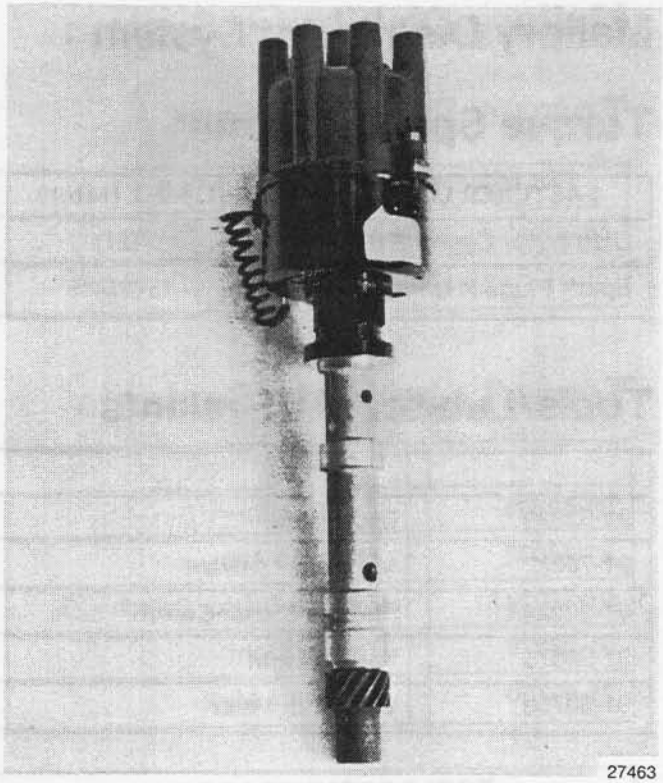
Mercury Marine Thunderbolt IV (HEI) Distributor



27463

Prestolite Distributor

Replacement Parts Warning

⚠WARNING

Electrical, ignition and fuel system components on your MerCruiser are designed and manufactured to comply with U.S. Coast Guard Rules and Regulations to minimize risks of fire and explosion.

Use of replacement electrical, ignition or fuel system components, which do not comply with these rules and regulations, could result in a fire or explosion hazard and should be avoided.

Mallory Distributor System

Torque Specifications

FASTENER LOCATION	LB. FT. (N·m)
Distributor Clamp 3/8-16	20 (27)
Spark Plugs (14mm)	15 (20)

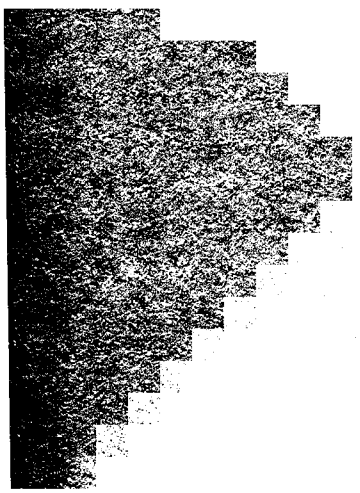
Tools/Lubricants/Sealants

	TOOLS
91-59339	Dwell Meter
91-76032	Magneto Analyzer
91-52024A1	Remote Starter Switch
91-99379	Timing Light
91-99750	Volt/Ohm Meter

TOOLS OBTAINED LOCALLY
Spring Tension Gauge

SEALANTS	
92-25711	Quicksilver Liquid Neoprene

LUBRICANT OBTAINED LOCALLY
Distributor Cam Lubricant



Specifications

UNIT OF MEASUREMENT
in. (mm)

Distributor

MODEL	MIE 5.7L SKI
Condenser*	.26 - .30 MFD.
Point Dwell	26° - 31°
Point Gap	.016 - .019 (.4 - .45)
Point Spring Tension	26 - 32 oz. (737 - 907g)

NOTE: *Use Magneto Analyzer

Coil

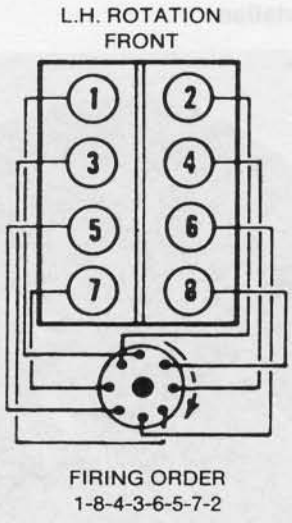
Coil Part No.	32193
Max. Operating Amps*	1.1
Primary Resistance*	1.1 - 1.5 ohms
Secondary Resistance*	9,500 - 15,000 ohms
Secondary Continuity*	60 - 70
Resistor Wire*	1.8 - 2 ohms

NOTE: *Use Magneto Analyzer

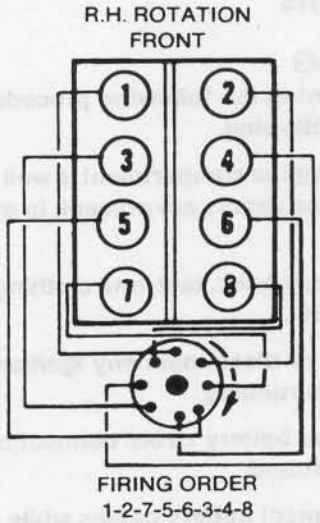
Spark Plugs

MODEL	MIE 5.7L SKI
Plug Gap	.035 (0.9)
Plug Type	AC-MR43T/Champion RV8C NGK-BR6FS

Firing Order



L.H. (Standard) Rotation

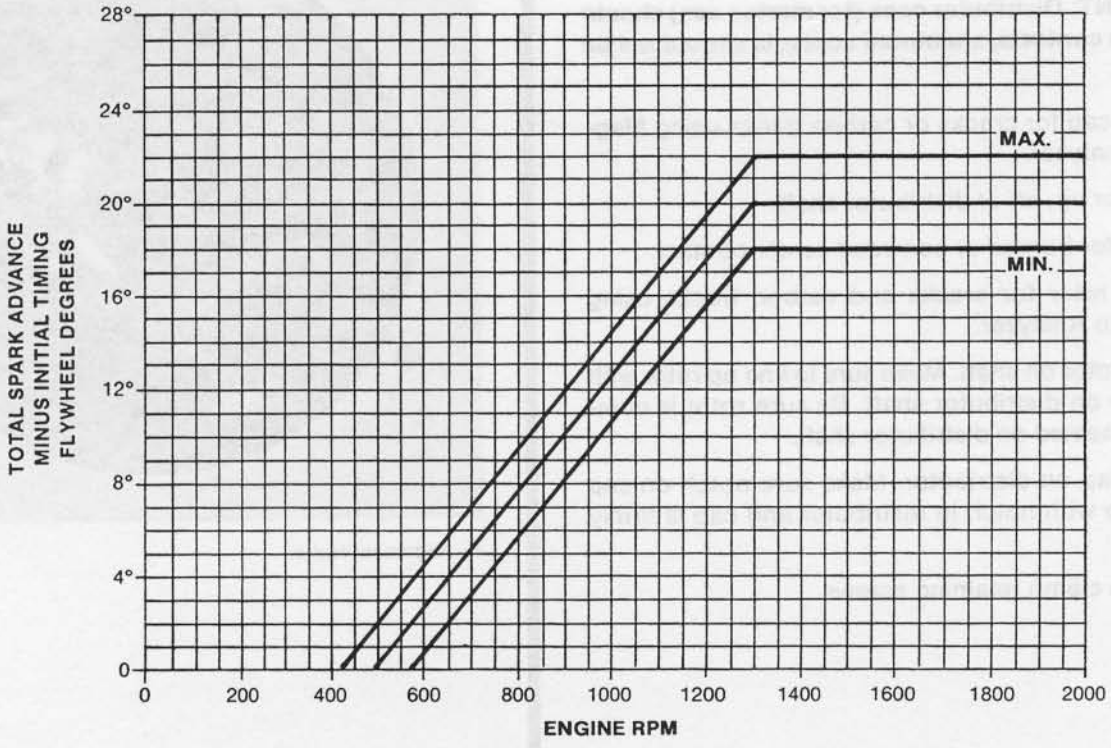


R.H. (Opposite) Rotation

Distributor Advance Curve

IMPORTANT: Distributor advance curve charts do not include the initial engine timing. Initial engine timing must be added to chart for total advance curve.

MIE 5.7L SKI



Repair

Precautions

⚠WARNING

When Performing the following procedure, be sure to observe the following.

Be sure that engine compartment is well ventilated and that no gasoline vapors are present, to avoid the possibility of fire.

Be sure to keep hands, feet, and clothing clear of moving engine parts.

Do not touch or disconnect any ignition system parts while engine is running.

Do not reverse battery cable connections. System is negative (-) ground.

Do not disconnect battery cables while engine is running.

Distributor Cap and Rotor

1. Loosen distributor cap clamp retaining screws.
2. Remove distributor cap.
3. Clean cap with warm soap and water and blow off with compressed air.
4. Check cap contact for excessive burning or corrosion. Check center contact for deterioration.

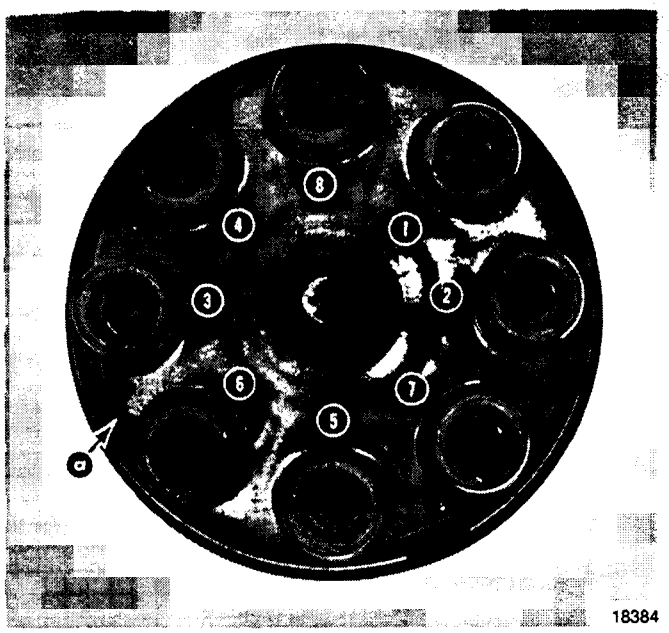
IMPORTANT: Distributor caps (for marine use) should have brass contacts, aluminum contacts should not be used.

5. Check cap for cracks or carbon tracks using Magneto Analyzer.
6. Lift rotor up, off of distributor shaft.
7. Check for burned or corroded center contact.
8. Check rotor for cracks and carbon tracks using Magneto Analyzer.
9. Install rotor on shaft. Make sure to line up rotor with keyway on distributor shaft. Be sure rotor is completely seated on distributor shaft.
10. Place cap on distributor. Make sure notch on cap lines up with notch in distributor and cap is firmly seated.
11. Tighten clamp retaining screws.
12. Install spark plug wires (if removed) as shown.

Left Hand Rotation

a - Alignment Notch

Right Hand Rotation



a - Alignment Notch

Contact Points

1. Examine contact points for dirt, wear, pitting and misalignment. Dirty points should be cleaned. Normal point condition is an overall grey color on contact surface.
2. Check for point resistance. A voltage drop of less than .125 volts across points should exist. Make this check with a sensitive volt meter or point resistance meter.

Abnormal Point Wear

1. Points, which have been operated for a period of time, have a rough surface, but this may not mean that points are worn out.
2. If points burn or pit, however, they soon become unsatisfactory for further operation. Not only must they be replaced, but ignition system and engine must be checked to determine cause and elimination of trouble. Unless condition is corrected, new points will provide no better service than old points.

Cleaning of Points

1. Dirty contact points should be dressed with a few strokes of a clean, fine-cut contact file. File should not be used on other metals and should not be allowed to become greasy or dirty.

IMPORTANT: Never use emery cloth to clean contact points.

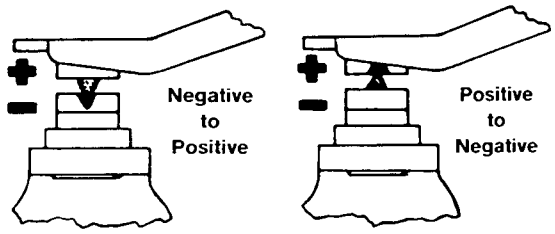
2. Contact surfaces, after considerable use, may not appear bright and smooth, but this is not necessarily an indication that they are not functioning satisfactorily. Do not attempt to remove all roughness nor dress point surfaces down smooth. Merely remove scale or dirt.
3. Badly burned or pitted contact points should be replaced and cause of trouble determined and corrected.

Burning of Points

1. Contact point burning results from high voltage, presence of oil or other foreign material, defective condenser or improper point adjustment.
2. High voltage causes excessively high current flow thru contact points which burns them rapidly. High voltage can result from improperly adjusted or inoperative voltage regulator.
3. Oil or crankcase vapors, which work up into distributor and deposit on point surfaces, cause them to burn rapidly.
4. If contact point opening is too small (cam angle too large), points will be closed too long. Average current flow thru points will be too high, so points will burn rapidly and arcing will occur between points.

Pitting of Points

1. Contact point pitting results from an out-of-balance condition in ignition system which causes transfer of material from one point to other so that a tip builds up on one point while a pit forms in other.

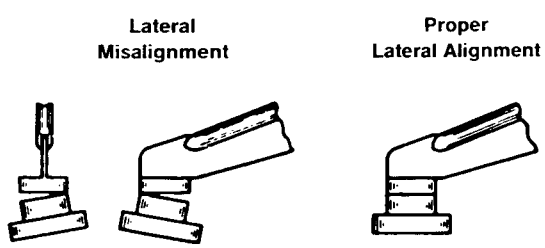


Replacement

1. Remove primary lead from primary terminal on distributor. Remove primary terminal screw and nut from distributor. (Use care not to lose the 2 insulator bushings in distributor housing.) Remove condenser lead and point lead from primary terminal screw.
2. Remove contact set attaching screw and lift contact point set from breaker plate.
3. Clean oil and dirt from breaker plate.

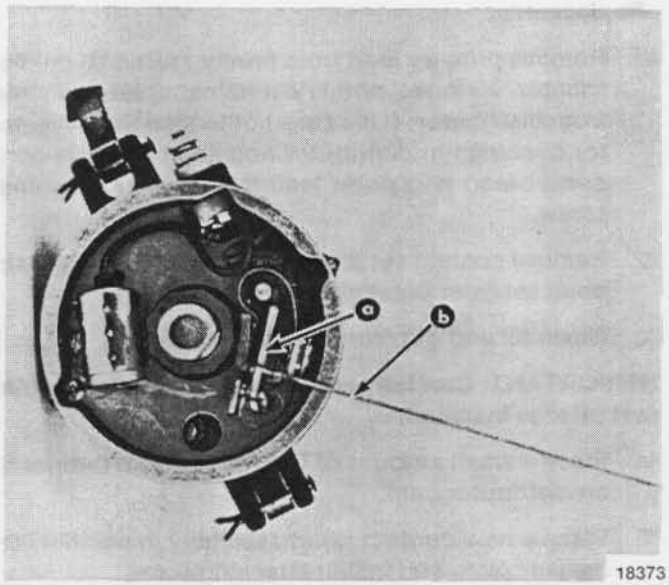
IMPORTANT: Carefully wipe protective film from point set prior to installation.

4. Place a small amount of Distributor Cam Lubricant on distributor cam.
5. Place a new contact point assembly in position on breaker plate and install attaching screw.
6. Place primary terminal screw through condenser lead and point lead. Install primary screw through 2 insulator bushings in distributor housing. Install primary terminal lock nut, primary lead, and primary lead retaining nut to primary terminal screw.
7. Check points for proper alignment. If points do not align properly, replace with another set of points.



8. Check point spring tension.

Contact point spring tension must fall within specified limits. Weak tension will cause chatter which results in arcing and burning of points and an ignition miss at high speed, while excessive tension will cause undue wear of contact points, cam and rubbing block. Contact point tension should be checked with a spring gauge. Scale should be hooked to breaker lever and pull exerted at 90° to breaker lever. Reading should be taken just as points separate. Tension can be adjusted by bending breaker lever spring. If tension is excessive, it can be decreased by pinching spring carefully. To increase tension remove lever from distributor so that spring can be bent away from lever. Avoid excessive spring distortion.

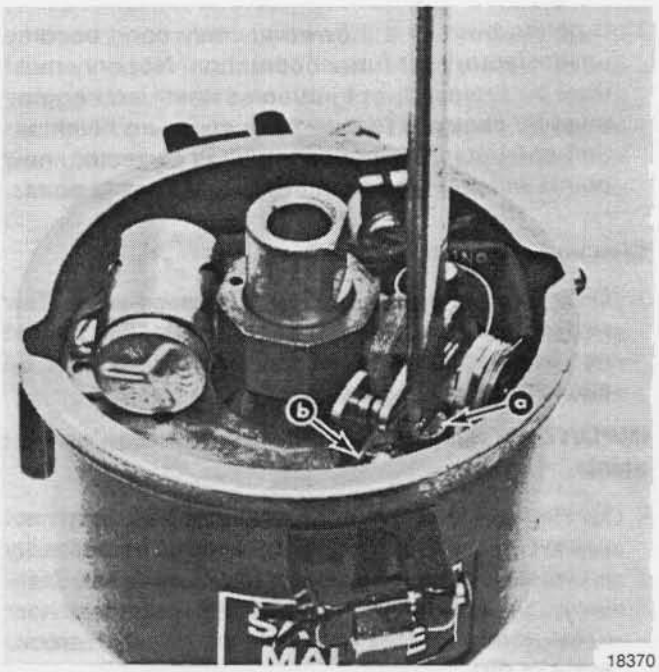


a - Movable Contact
b - Spring Tension Gauge

Point Adjustment with Feeler Gauge

IMPORTANT: Point gap (dwell) can be adjusted by 2 methods. It is preferred that points be adjusted with a feeler gauge, then checked with a dwell meter. Points, however, also can be adjusted, as well as checked, with a dwell meter: After points have been set, dwell should be checked with engine running.

1. Rotate distributor until rubbing block rests on peak of cam lobe, which will provide maximum breaker point opening.
2. Insert correct feeler gauge between breaker points.
3. Loosen lockscrew and adjust points to specifications.



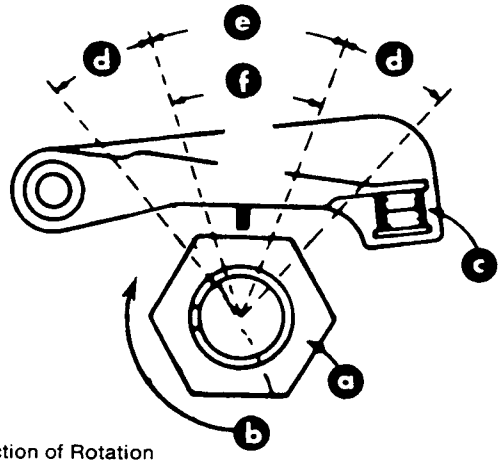
a - Adjustment Screw
b - Locking Screw

Point Adjustment

Dwell Adjustment

1. Remove distributor cap and rotor.
2. Connect positive (+) dwell meter lead to negative (-) side of coil. Connect negative (-) meter lead to ground.
3. Loosen point lock screw slightly.
4. While cranking engine with starter, adjust dwell with a screwdriver to obtain reading on dwell meter, as specified in "Specifications," and tighten lockscrew. (Dwell reading will be unsteady using this method.)

IMPORTANT: Cam angle increased as point opening is decreased and vice versa.



a - Cam
b - Direction of Rotation
c - Breaker Points
d - Points Open
e - Points Close
f - Cam Angle or Dwell

5. Install rotor and distributor cap and recheck dwell with engine running.

IMPORTANT: Dwell should be checked between idle and 1750 RPM. Any dwell reading variations of more than 3° between idle and 1750 RPM would indicate wear in the distributor.

Cam angle readings, taken at speeds above 1750 engine RPM, may prove unreliable on some dwell meters.

Condenser

1. Use Magneto Analyzer for test.
2. Test condenser for the following:
   a. Condenser capacity test.
   b. Condenser leakage and short test.
   c. Coil continuity test.
   d. Primary resistance test.
   e. Secondary resistance test.
3. Replace coil if test results are not within specfications.

Coil

1. Use Magneto Analyzer for test.
2. Check coil for the following:
   a. Coil power test.
   b. Coil surface insulation test.
   c. Coil continuity test.
   d. Primary resistance test.
   e. Secondary resistance test.
3. Replace coil if test results are not within specfications.

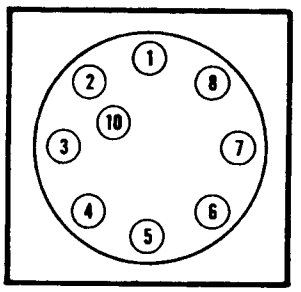
Ignition Resistance Wire

Engine with Electric Choke

1. Disconnect wire from positive (+) side of coil.
2. Unplug quick disconnect (with 2 wires) from electric choke heater element.
3. Connect ohmmeter leads to ends of disconnected wires. Replace resistor wire if reading is not within specifications.
4. Reconnect wires to coil and choke.
5. For instructions on replacing resistor wire refer to "Section 3, Part E."

Engine without Electric Choke

1. Disconnect wire from positive (+) side of coil.
2. Unplug instrumentation harness from engine harness.
3. Connect one ohmmeter lead to wire removed from coil. Connect other ohmmeter lead to No. 5 pin hole in engine harness. Replace resistor wire if reading is not within specifications.



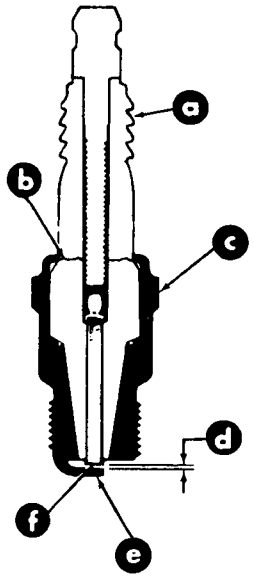
Engine Harness Connector

4. Reconnect wire to coil. Plug instrumentation harness onto engine harness and tighten retaining clamp securely.
5. For instructions on replacing resistor wire refer to "Section 3, Part E."

Spark Plugs

1. Inspect each plug individually for badly worn electrodes, glazed, broken or blistered porcelain and replace where necessary.
2. Inspect each spark plug for make and heat range. All plugs must be the same make and number or heat range. Refer to "Specifications" for spark plug numbers.

3. Adjust spark plug gaps with a round feeler gauge. Refer to "Specifications" for proper spark plug gap.



a - Porcelain Insulator
b - Insulator Cracks Often Occur at this Point
c - Shell
d - Proper Gap
e - Side Electrode (Bend to Adjust Gap)
f - Center Electrode (File Flat When Adjusting Gap)

4. Clean spark plug seating area. DO NOT use gaskets on taper seat plugs. Install spark plugs and torque to specifications. Where used, gasket must be fully compressed to complete heat transfer and provide a gas-tight seal in cylinder. For this reason, as well as necessity of maintaining correct plug gap, correct torque is very important during installation.

IMPORTANT: Tapered seat spark plugs are not interchangeable with nontapered (with gasket) spark plugs.

High Tension Leads

1. Inspect high tension leads for damage.
2. Check high tension leads for continuity.
3. Replace any leads that are cracked, cut, or have damaged spark plug boots.
4. Replace any leads that do not show continuity from end to end.
5. Reinstall high tension leads in proper order.

IMPORTANT: Proper positioning in high tension lead supports is important to prevent cross firing.

Distributor Repair

Removal

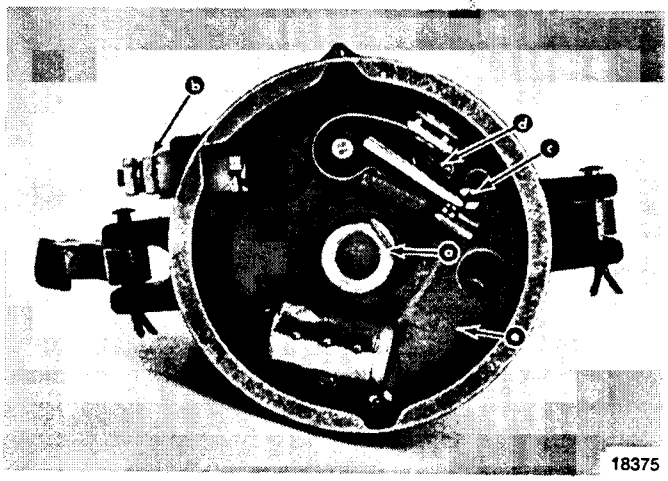
1. Remove distributor cap (2 screws) and gasket. Do not remove plug wires from cap unless necessary.
2. Disconnect coil primary lead from distributor.
3. Crank or turn engine slowly. Align timing marks when rotor is pointing to No. 1 terminal of distributor cap. If same distributor is to be reinstalled in engine, mark position of distributor housing in relation to engine so that distributor may be installed in same position.
4. Remove distributor retaining clamp.
5. Remove distributor.

IMPORTANT: To simplify distributor installation, do not turn crankshaft with distributor removed from engine.

Disassembly

IMPORTANT: It is not necessary to disassemble distributor any further than required to complete repairs.

1. Lift rotor off of distributor shaft.
2. Remove condenser and breaker points and test as previously outlined.
3. Mark breaker plate location and remove 2 retaining screws. Remove breaker plate.



a - Rotor Alignment Notch
b - Primary Terminal
c - Breaker Point Attaching Screw
d - Breaker Point Adjustment Screw
e - Breaker Plate

4. Remove pin from driven gear and shaft and remove gear from shaft.
5. Remove washer(s) from shaft. (If there are 2 washers, the steel washer goes towards housing and the brass washer towards gear.)

IMPORTANT: Housing bushings are not serviced separately. (Refer to parts manual.)

6. Check for side play between shaft and housing bushings. Maximum side play is .002 in. (.05mm).
7. Remove and check shaft for being bent by placing in V-blocks and checking run out with a dial indicator. Maximum run out allowed is .002 in. (.05mm) (retain washer between advance mechanism and distributor housing).
8. Check cam lobes for wear and cam should fit tight on shaft. Advance plate should fit tight on shaft.

IMPORTANT: Shaft, advance mechanism and cam are serviced as an assembly and should not be disassembled. (Refer to parts manual.)

9. Check advance mechanism for free movement. Mechanism should return freely when released.

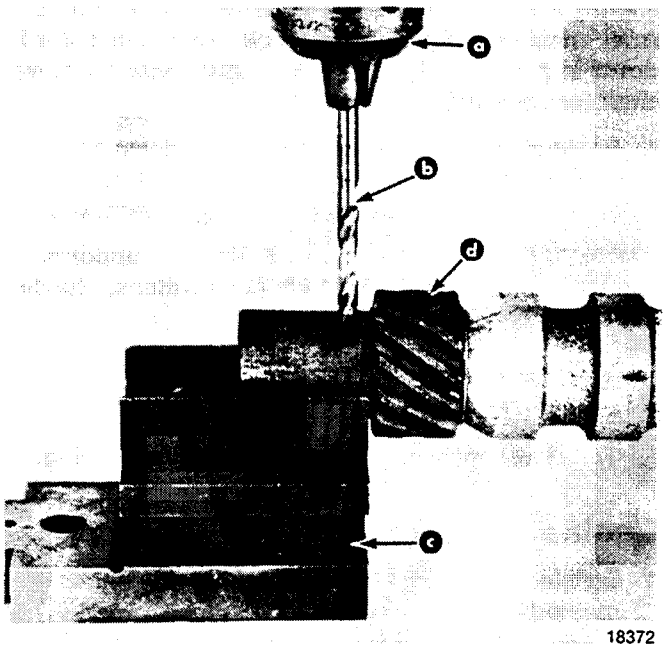
Reassembly

1. Install washer on shaft assembly and lubricate shaft with engine oil. Install shaft in housing.
2. Install washer(s) on shaft between housing and gear (if there are 2 washers, steel goes toward housing and brass goes toward gear).
3. If installing original driven gear slide onto shaft and install roll pin.

IMPORTANT: Hole in gear is offset, gear will fit on shaft and line up with hole only one way.

4. If installing a new driven gear the gear will not come drilled all the way through. Install gear on shaft. Turn gear to line up the hole with the hole in shaft. Using hole in gear and hole in shaft as a guide, drill through other side of gear with a 3/16 in. carbide tipped drill, install roll pin.

IMPORTANT: If new gear has only a dimple, you will have to drill through one side of the gear before you slide gear onto shaft. In most cases it is recommended to have a machine shop complete the drilling operation for new gear installation.



18372

a - Drill Press
b - 3/16 in. Carbide Tip Drill
c - V-Block
d - New Gear

5. Install breaker plate using alignment mark to properly locate.
6. Install points, condensor, and primary terminal screw.
7. Install distributor as outlined in "Distributor Installation".

Distributor Installation

Engine Not Disturbed

1. Install new gasket on distributor housing.
2. Turn rotor approximately 1/8-turn in a counterclockwise direction past mark previously scratched on distributor housing.
3. Work distributor down into position in engine block with distributor positioned as noted during removal.

IMPORTANT: It may be necessary to move rotor slightly to start gear into mesh with camshaft gear, but rotor should line up with the mark when distributor is down in place. Distributor shaft must enter oil pump shaft for complete installation.

4. Replace and tighten distributor hold-down bolt and clamp. Connect primary lead to coil. Also install spark plug and coil secondary wires, if removed.

IMPORTANT: Wires must be installed in supports, to prevent cross-firing. Refer to "Specifications," for firing order.

5. Set point gap and dwell.
6. Install rotor and cap.
7. Time ignition as outlined under "Ignition Timing."

Engine Disturbed

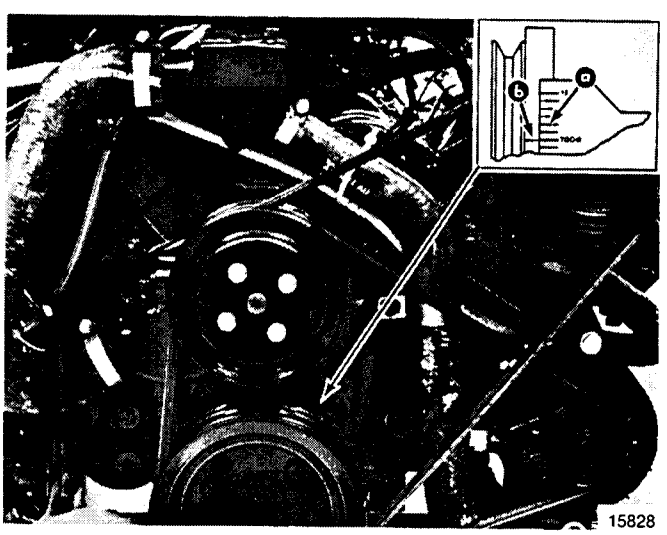
1. Locate No. 1 piston in firing position by either of 2 methods.
   a. Remove No. 1 spark plug and, with finger on plug hole, crank engine until compression is felt in No. 1 cylinder. Continue cranking until pointer lines up with timing mark on crankshaft pulley or . . .
   b. Remove rocker cover and crank engine until No. 1 intake valve closes, continuing to crank slowly until pointer lines up with timing mark on crankshaft pulley.
2. Position distributor to opening in block in normal installed attitude.
3. Position rotor to point toward No. 1 cylinder on cap (with distributor housing held in installed attitude), then turn rotor counterclockwise approximately 1/8-turn more and push distributor down to engage camshaft. It may be necessary to rotate rotor slightly until camshaft engagement is felt.
4. While pressing down firmly on distributor housing, engage starter a few times to make sure oil pump shaft is engaged. Install hold-down clamp and bolt and snug up bolt.
5. Turn distributor body slightly until points just open and tighten distributor clamp bolt.
6. Place distributor cap in position and check that rotor lines up with terminal for No. 1 spark plug.
7. Install cap, distributor primary lead to coil. Check all high tension wire connections and connect spark plug wires, if they have been removed. Wires must be installed in their proper location in supports to prevent cross-firing. Refer to "Specifications" for firing order.
8. Set point gap and dwell.
9. Time ignition as outlined under "Ignition Timing."

Ignition Timing

IMPORTANT: Dwell must be set to specification before adjusting timing.

1. Connect timing light to No. 1 spark plug. Connect power supply leads on light to battery (12 volts). Refer to "Specification" for cylinder numbering and location.
2. Connect tachometer to engine.
3. Start engine and run at normal idle speed.
4. Aim timing light at timing tab, located on timing gear cover and crankshaft harmonic balancer.

IMPORTANT: GM engine timing marks (on tab) are in 2° increments. MCM and MIE L.H. engines will have the "A" (Advance) mark to the left of "O." MIE R.H. engines will have the "A" mark to the right of "O." Timing must be set on the "A" side of "O" (Top Dead Center).



a - Degree Marks
b - Timing Marks

Timing Tab on "GM" V-8 Engine

5. Adjust timing by loosening distributor clamp and rotating distributor body as required until timing mark on balancer or pulley lines up with mark on tab specified in "Specifications." Tighten clamp and recheck location of timing mark.
6. Stop engine and remove timing light.

Thunderbolt IV (HEI) System

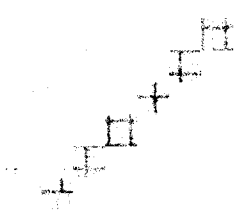
Torque Specifications

FASTENER LOCATION	LB. FT. (N-m)
Distributor Clamp 3/8-16	20 (27)
Spark Plugs (14mm)	15 (20)

Tools/Lubricants/Sealants

TOOLS	
91-52024A1	Remote Starter Switch
91-63998	Spark Gap Tester
91-99379	Timing Light
91-63209	Torch Lamp
91-99750	Volt/Ohmmeter

LUBRICANTS/SEALANTS	
92-90018	2-4-C Lubricant
92-41669	Insulating Compound
92-25711	Liquid Neoprene
92-32609	Quicksilver Loctite "A"



Specifications

UNIT OF MEASUREMENT in. (mm)

Coil

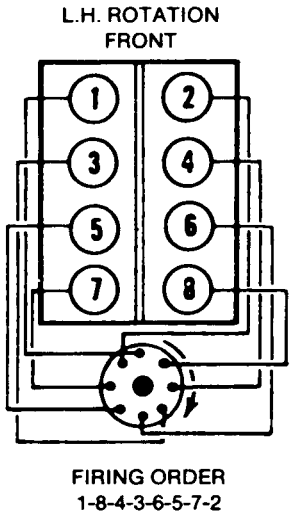
Coil Part Number	392-7803
Primary Resistance*	.60 - .80 Ohms
Secondary Resistance*	9,400 - 11,700 Ohms

NOTE: *Use Magneto Analyzer

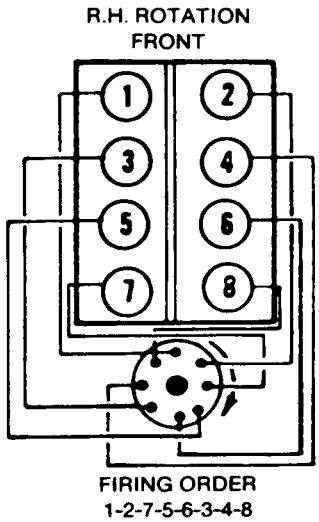
Spark Plugs

MODEL	ALL MIE and MCM
Spark Plug Gap	.035 (0.9)
Spark Plug Type	AC-MR43T NGK-BR6FS Champion RV8C

Firing Order



All MCM/MIE L.H. (Standard) Rotation Models



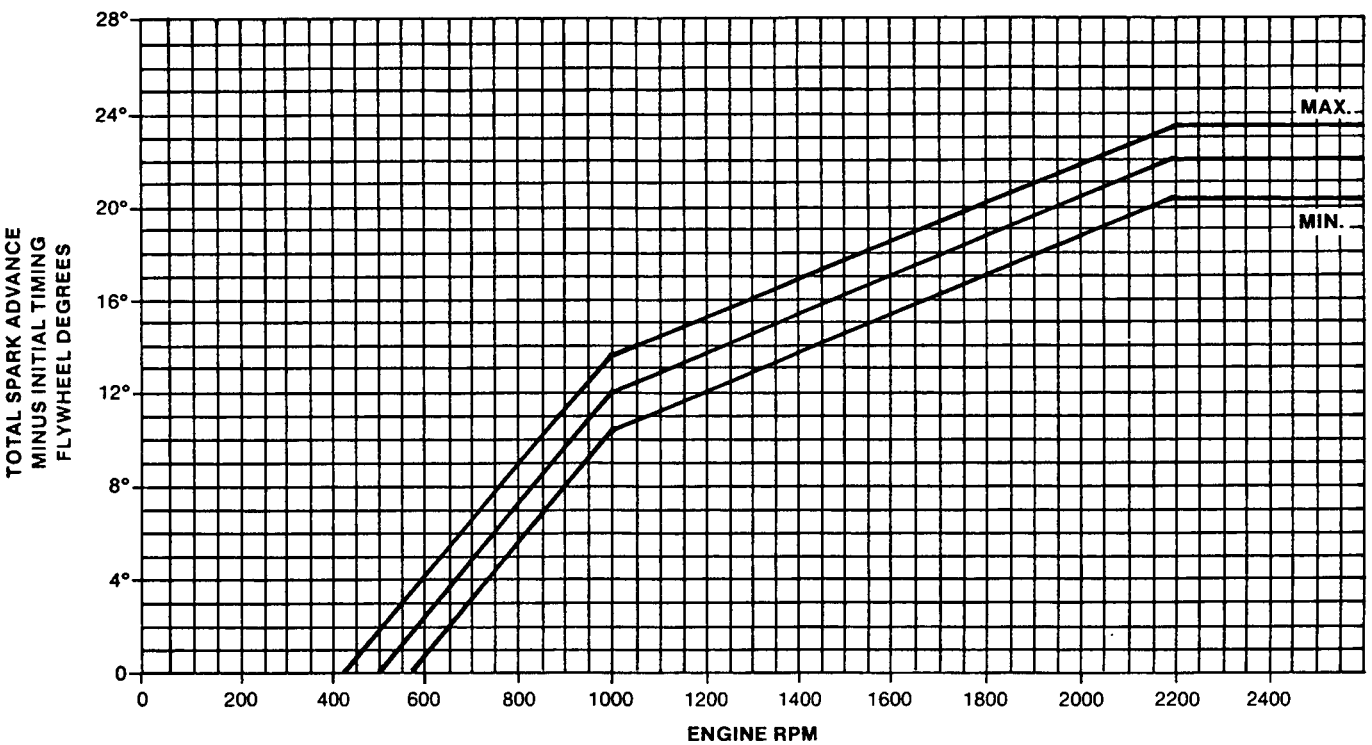
MIE R.H. (Opposite) Rotation

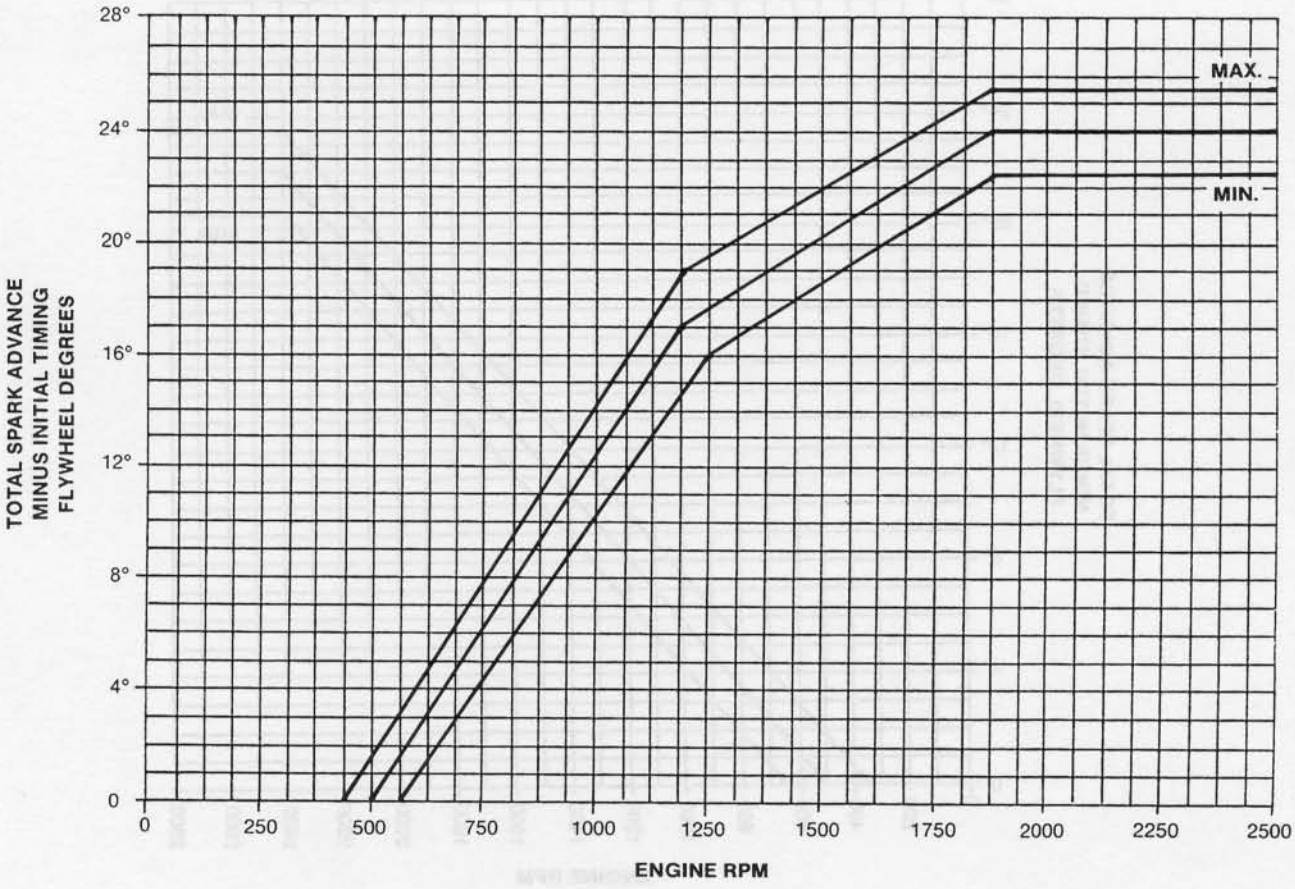
Distributor Advance Curves

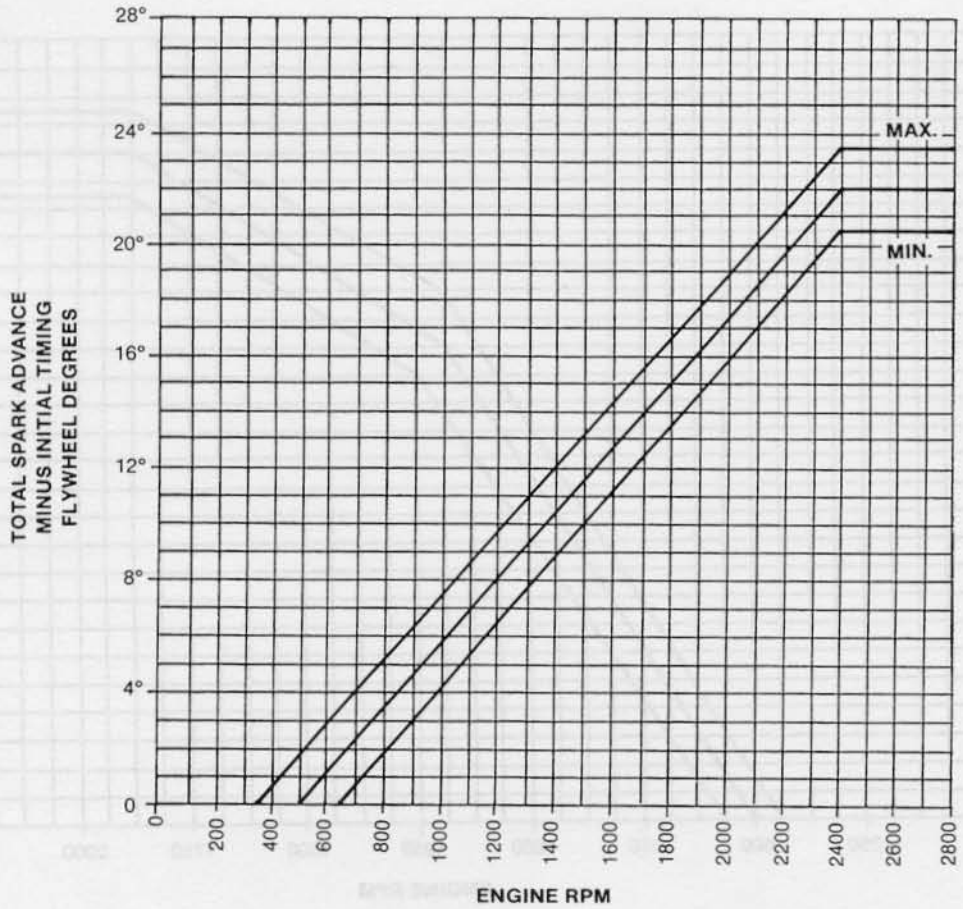
IMPORTANT: Distributor advance curve charts do not include the initial engine timing. Basic initial timing must be added to chart for total advance curve.

IMPORTANT: On the HEI ignition the spark advance is controlled by the amplifier.

MCM 5.0/5.0LX/5.7 LITRE/350 MAGNUM
MIE 5.0/5.7 LITRE




28°
24°
20°
16°
12°
8°
4°
0
MAX.
MIN.
TOTAL SPARK ADVANCE
MINUS INITIAL TIMING
FLYWHEEL DEGREES
0
250
500
750
1000
1250
1500
1750
2000
2250
2500
ENGINE RPM


TOTAL SPARK ADVANCE
MINUS INITIAL TIMING
FLYWHEEL DEGREES
28°
24°
20°
16°
12°
8°
4°
0
MAX.
MIN.
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
ENGINE RPM

Repair

Precautions

⚠WARNING

When performing the following procedure, be sure to observe the following.

Be sure that engine compartment is well ventilated and that no gasoline vapors are present, to avoid the possibility of fire.

Be sure to keep hands, feet, and clothing clear of moving parts.

Do not touch or disconnect any ignition system parts while engine is running.

Do not reverse battery cable connections. System is negative (-) ground.

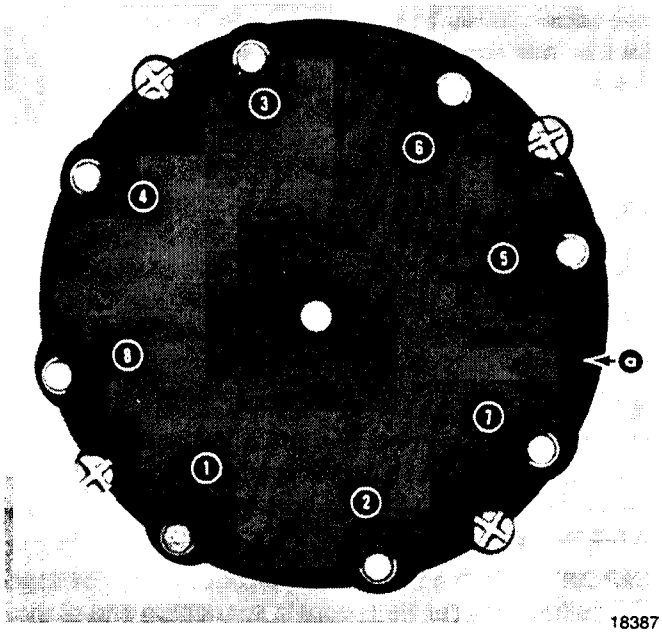
Do not disconnect battery cables while engine is running.

Distributor Cap

1. Loosen four distributor cap retaining screws.
2. Remove distributor cap.
3. Clean cap with warm soap and water and blow off with compressed air.
4. Check cap contact for excessive burning or corrosion. Check center contact for deterioration.
5. Check cap for cracks or carbon tracks using Magneto Analyzer.

IMPORTANT: If high tension leads are removed from cap refer to Figures following for installation.

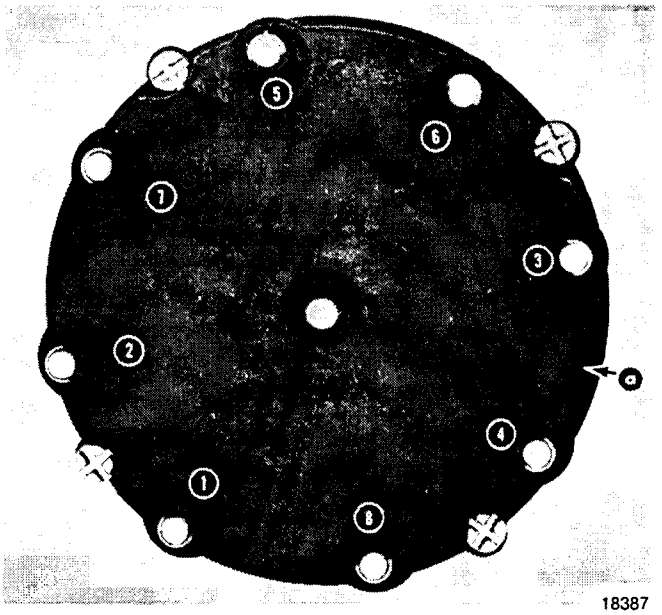
L.H. Rotation Wiring



18387

a - Alignment Notch

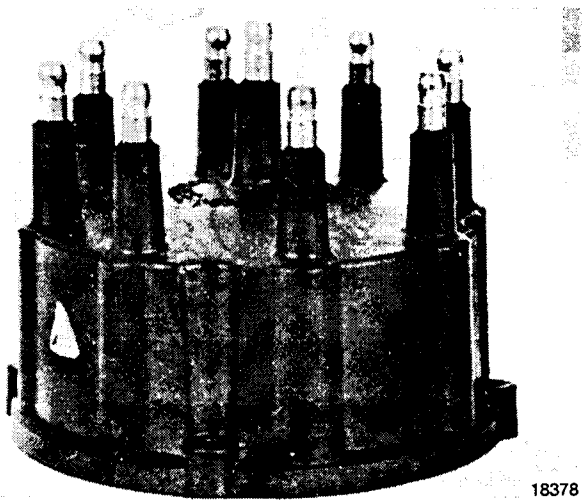
R.H. Rotation Wiring



18387

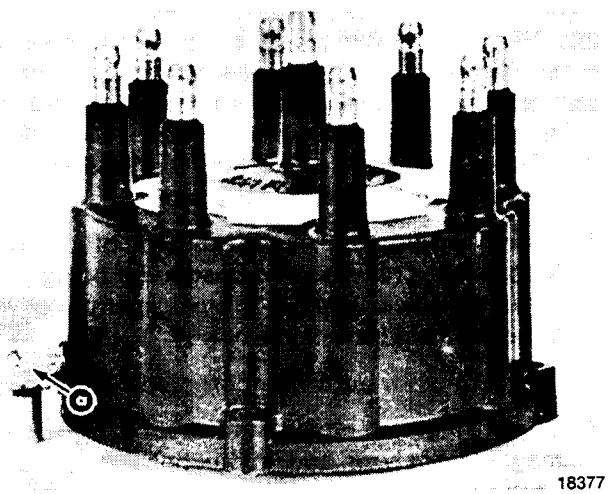
a - Alignment Notch

Non Vented Cap



18378

Vented Cap

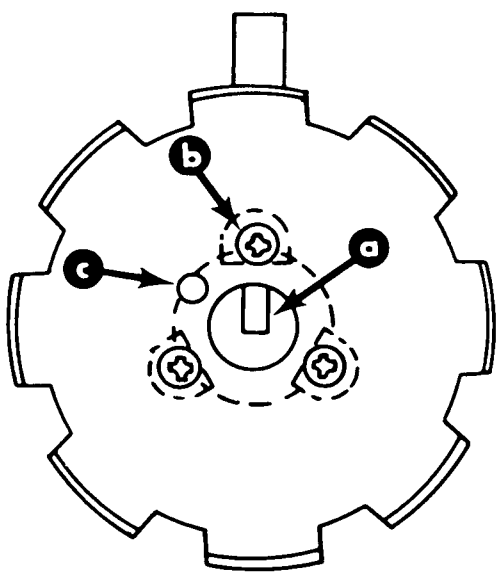


18377

a - Vent

Rotor and Sensor Wheel

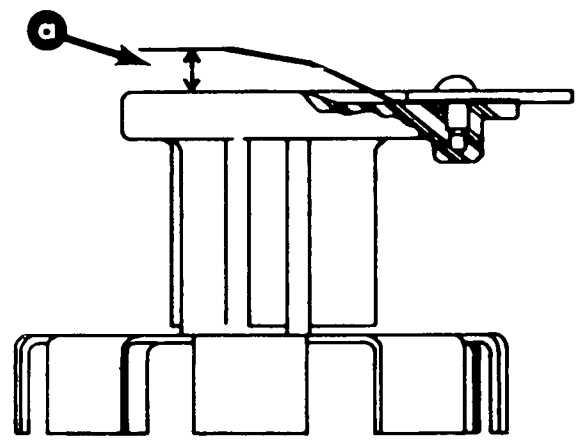
1. Remove distributor rotor/sensor wheel assembly from distributor shaft. Rotor and sensor wheel are Loctited onto shaft. Use two 3/8 in. (10mm) wide flat blade screwdrivers approximately 8 in. (203mm) to 10 in. (254mm) long. The screwdrivers are positioned opposite each other with the blade tips on the underside of the rotor and sensor wheel assembly. Make sure blade tips are toward distributor shaft until they come in contact with shaft. A downward push on both screwdriver handles at the same time will pry rotor and sensor wheel assembly off. The use of Torch Lamp will also aid in the removal of the rotor/sensor wheel assembly.
2. With the rotor and sensor wheel assembly removed, inspect the locating key inside the rotor.
3. The locating key will appear as a clean edged, 1/8 in. (3mm) wide, sloped ramp at the bottom of the splined hole.



a - Locating Key
b - Phillips Screws
c - Sensor Wheel
d - Locating Pin

IMPORTANT: If there is any doubt if sensor wheel is located properly, lay sensor wheel on top of Figure with sensor fingers facing up (toward you). Line up 3 screw holes and locating pin hole on sensor wheel with Figure. If wheel is indexed properly all the fingers on wheel will line up with the one in the Figure.

4. If there are pieces of material shaved off of key or if it appears to have been damaged by being forced down while misaligned with slot in distributor shaft, the rotor must be replaced.
5. Check rotor for burned or corroded center contact.
6. Check rotor for cracks and carbon tracks using magneto analyzer and instructions supplied with analyzer.
7. If rotor is damaged, replace rotor by removing 3 phillips screws and separating sensor wheel from rotor. Reinstall sensor wheel to new rotor making sure locating pin on rotor is installed in locating hole in sensor wheel. Tighten 3 phillips screws securely.
8. Bend carbon brush tang upward slightly until a distance of 1/4 in. (6.5mm) is obtained between rotor and tang.



a - 1/4 in. (6.5mm)

9. Put 2 drops of Loctite 271 or Loctite Type "A" into the rotor so it lands on the locating key.
10. Put 2 drops of Loctite in keyway on upper portion of distributor shaft.
11. Immediately install rotor assembly onto distributor shaft. Make sure rotor locating key is aligned with keyway in distributor shaft before pressing rotor all the way down on shaft until it stops with the palm of your hand. Let Loctite cure overnight with distributor in inverted position.

IMPORTANT: The rotor should fit very tight. It may be necessary to heat rotor with Torch Lamp to properly install. It is important not to let any Loctite run down distributor shaft. Loctite could get into top distributor housing bushing.

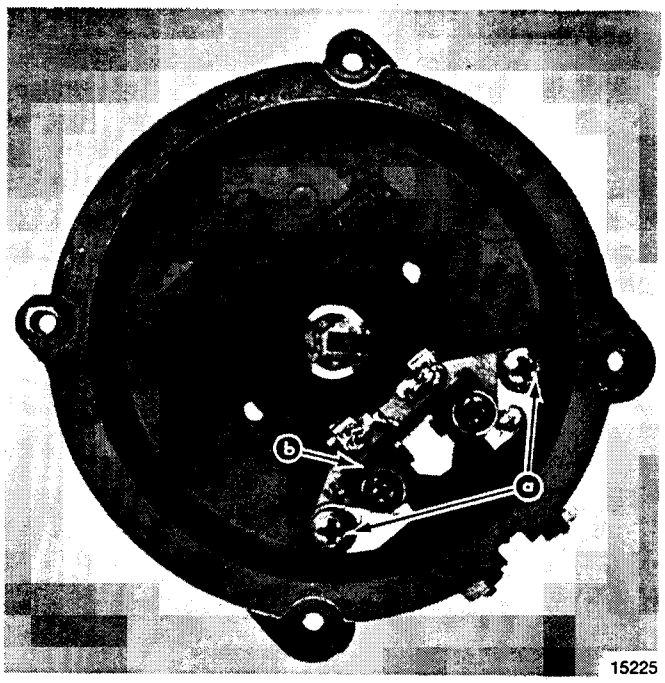
12. Reinstall distributor cap on distributor.
13. Install spark plug wires (if removed) as shown previously. Apply a small quantity of Insulating Compound to the inside of each spark plug wire boot before installing the boot on distributor cap. Wipe off excess. This Insulating Compound will help "waterproof" this area of the ignition system.

IMPORTANT: Make sure boot does not "hydraulic" back off of distributor cap terminal. If it does, use needle nose pliers and bend metal spark plug wire terminal (inside of boot) slightly so it grips the distributor cap terminal tighter.

IMPORTANT: Black boot is distributor end of spark plug wire. Gray (or Red) boot is spark plug end of wire.

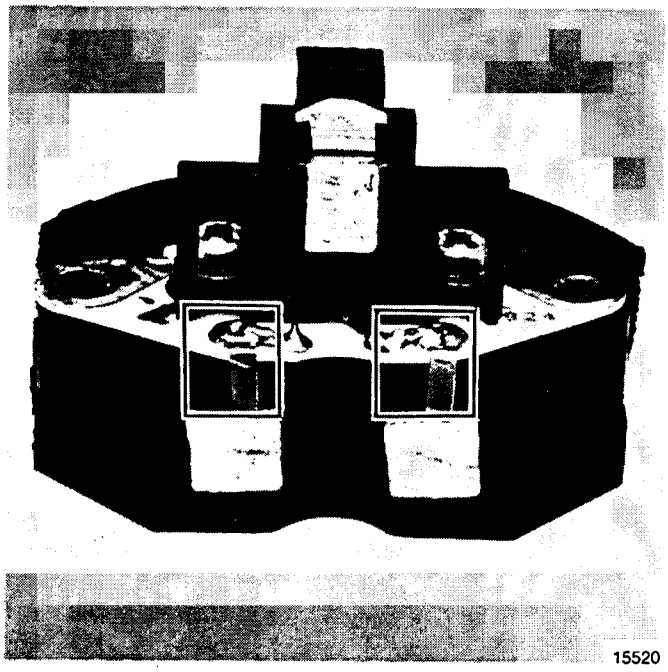
Sensor

1. Remove rotor and sensor wheel.
2. Remove 2 screws that hold sensor into distributor housing.
3. Remove sensor from housing.



a - Mounting Screws
b - Sensor Assembly

4. Use a magnifying glass and light to inspect the two metal "jumper lead" for cracks. If a crack is found in either metal "jumper lead," install a new sensor.



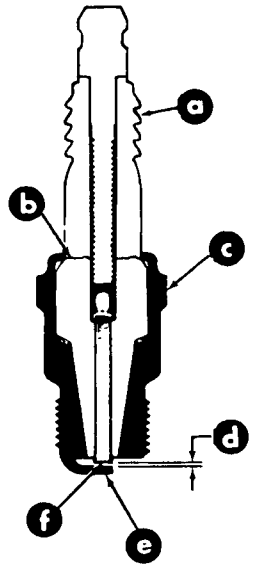
⚠CAUTION

Do not use any type of silicone sealer on the inside of the distributor. Most silicone sealers give off an acidic vapor during the curing stage of the sealer. This acid can cause corrosion on the ignition components.

5. Install sensor into housing and install 2 retaining screws.
6. Install sensor wheel, rotor, and distributor cap.

Spark Plugs

1. Inspect each plug individually for badly worn electrodes, glazed, broken or blistered porcelain and replace where necessary.
2. Inspect each spark plug for make and heat range. All plugs must be the same make and number or heat range. Refer to "Specifications" for spark plug numbers.
3. Adjust spark plug gaps with a round feeler gauge. Refer to "Specification" for proper spark plug gap.



a - Porcelain Insulator
b - Insulator Cracks Often Occur at this Point
c - Shell
d - Proper Gap
e - Side Electrode (Bend to Adjust Gap)
f - Center Electrode (File Flat When Adjusting Gap)

4. Clean spark plug seating area. Do not use gaskets on taper seat plugs. Install spark plugs and torque to specifications. Where used, gasket must be fully compressed to complete heat transfer and provide a gas-tight seal in cylinder. For this reason, as well as necessity of maintaining correct plug gap, correct torque is very important during installation.

IMPORTANT: Tapered seat spark plugs are not interchangeable with nontapered (with gasket) spark plugs.

High Tension Leads

1. Inspect high tension leads for damage.
2. Check high tension leads for continuity.
3. Replace any leads that are cracked, cut, or have damaged spark plug boots.
4. Replace any leads that do not show continuity from end to end.
5. Reinstall high tension leads in proper order.

IMPORTANT: Proper positioning in high tension lead supports is important to prevent cross-firing.

IMPORTANT: Black boot is distributor end of spark plug wire. Gray (or Red) boot is spark plug end of wire.

Distributor Repair

Removal

1. Remove distributor cap. Do not remove high tension leads unless necessary.
2. Crank engine over until timing marks line up and rotor is pointing towards No. 1 cylinder on distributor cap.
3. Mark distributor housing in reference to engine block.
4. Remove bolt and hold down clamp and remove distributor.

IMPORTANT: To simplify distributor installation, do not turn crankshaft with distributor removed from engine.

Disassembly

1. Remove rotor, sensor wheel, and sensor as previously outlined.
2. Remove roll pin, washer and driven gear from distributor shaft.
3. Check for side play between shaft and distributor housing bushings. Maximum side play is .002 in. (.05mm).
4. Remove shaft from housing and check shaft for being bent with a dial indicator and V-blocks. Maximum runout is .002 in. (0.5mm).

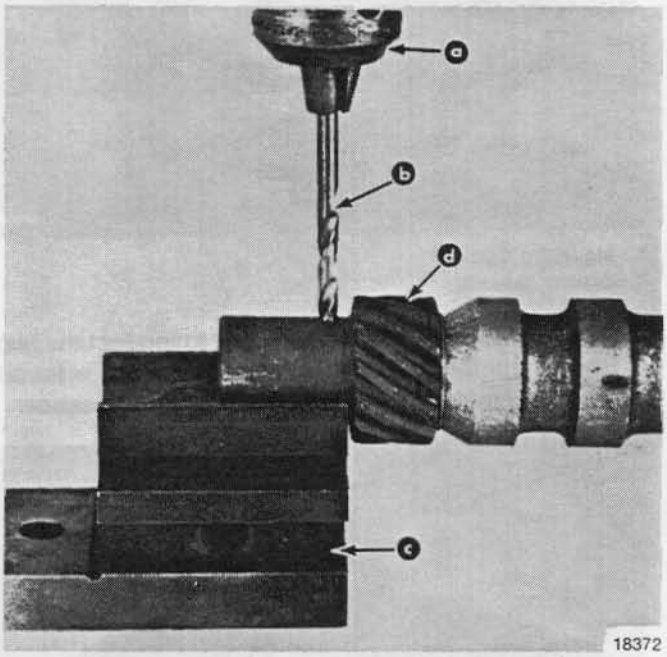
Reassembly

1. Lubricate shaft with engine oil. Install "E" clip (if removed) on shaft. Install shaft in housing.
2. Install washer on shaft. Install original gear slide onto shaft and install roll pin.

IMPORTANT: Hole may be offset and gear will only fit in one direction.

3. If installing a new gear, the gear will come drilled on one side. Slide gear onto shaft, line hole in gear with hole in shaft. Using these holes as guides, drill through other side of gear with a 3/16 in. carbide tipped drill.

IMPORTANT: If a new gear has only a dimple, you will have to drill through one side of the gear before you slide gear onto shaft. In most cases it is recommended to have a machine shop complete the drilling operation for new gear installation.



a - Drill Press
b - 3/16 in. Carbide Tip Drill
c - V-Block
d - New Gear

4. Install sensor, sensor wheel, and rotor as previously outlined.
5. Install distributor as outlined in "Distributor Installation".

Distributor Installation

Engine Not Disturbed

1. Install new gasket on distributor housing.
2. Turn rotor approximately 1/8-turn in a counterclockwise direction past mark previously scratched on distributor housing.
3. Work distributor down into position in engine block with distributor positioned as noted during removal.

IMPORTANT: It may be necessary to move rotor slightly to start gear into mesh with camshaft gear, but rotor should line up with the mark when distributor is down in place. Distributor shaft must enter oil pump shaft for complete installation.

4. Replace and tighten distributor hold-down bolt and clamp. Connect leads. Also install spark plug and coil secondary wires, if removed.

IMPORTANT: Wires must be installed in supports, to prevent cross-firing. Refer to "Specifications," for firing order.

5. Install cap.
6. Time ignition as outlined under "Ignition Timing."

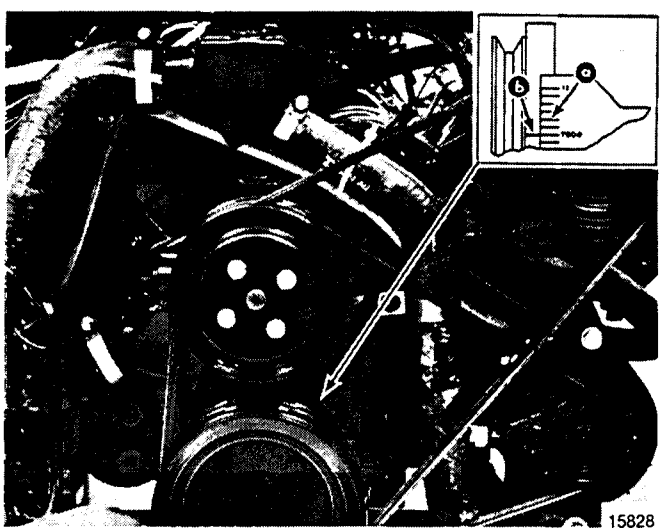
Engine Disturbed

1. Locate No. 1 piston in firing position by either of 2 methods described below.
   a. Remove No. 1 spark plug and, with finger on plug hole, crank engine until compression is felt in No. 1 cylinder. Continue cranking until pointer lines up with timing mark on crankshaft pulley or . . .
   b. Remove rocker cover and crank engine until No. 1 intake valve closes, continuing to crank slowly until pointer lines up with timing mark on crankshaft pulley.
2. Position distributor to opening in block in normal installed attitude.
3. Position rotor to point toward No. 1 cylinder on cap (with distributor housing held in installed attitude), then turn rotor counterclockwise approximately 1/8-turn more and push distributor down to engage camshaft. It may be necessary to rotate slightly until camshaft engagement is felt.
4. While pressing down firmly on distributor housing, engage starter a few times to make sure oil pump shaft is engaged. Install hold-down clamp and bolt and snug up bolt.
5. Place distributor cap in position and check that rotor lines up with terminal for No. 1 spark plug.
6. Install cap and distributor leads. Check all high tension wire connections and connect spark plug wires, if they have been removed. Wires must be installed in their proper location in supports to prevent cross-firing. Refer to "Specifications" for firing order.
7. Time ignition as outlined under "Ignition Timing."

Ignition Timing

1. Connect timing light to No. 1 spark plug. Connect power supply leads on light to battery (12 volts). Refer to "Specifications" for cylinder numbering and location.
2. Connect tachometer to engine.
3. Start engine and run at normal idle speed.
4. Aim timing light at timing tab, located on timing gear cover and crankshaft harmonic balancer.

IMPORTANT: GM engine timing marks (on tab) are in 2° increments. MCM and MIE L.H. engines will have "A" (Advance) mark to left of "O." MIE R.H. engines will have the "A" mark on the right of "O." Timing must be set on the "A" side of "O" (Top Dead Center).

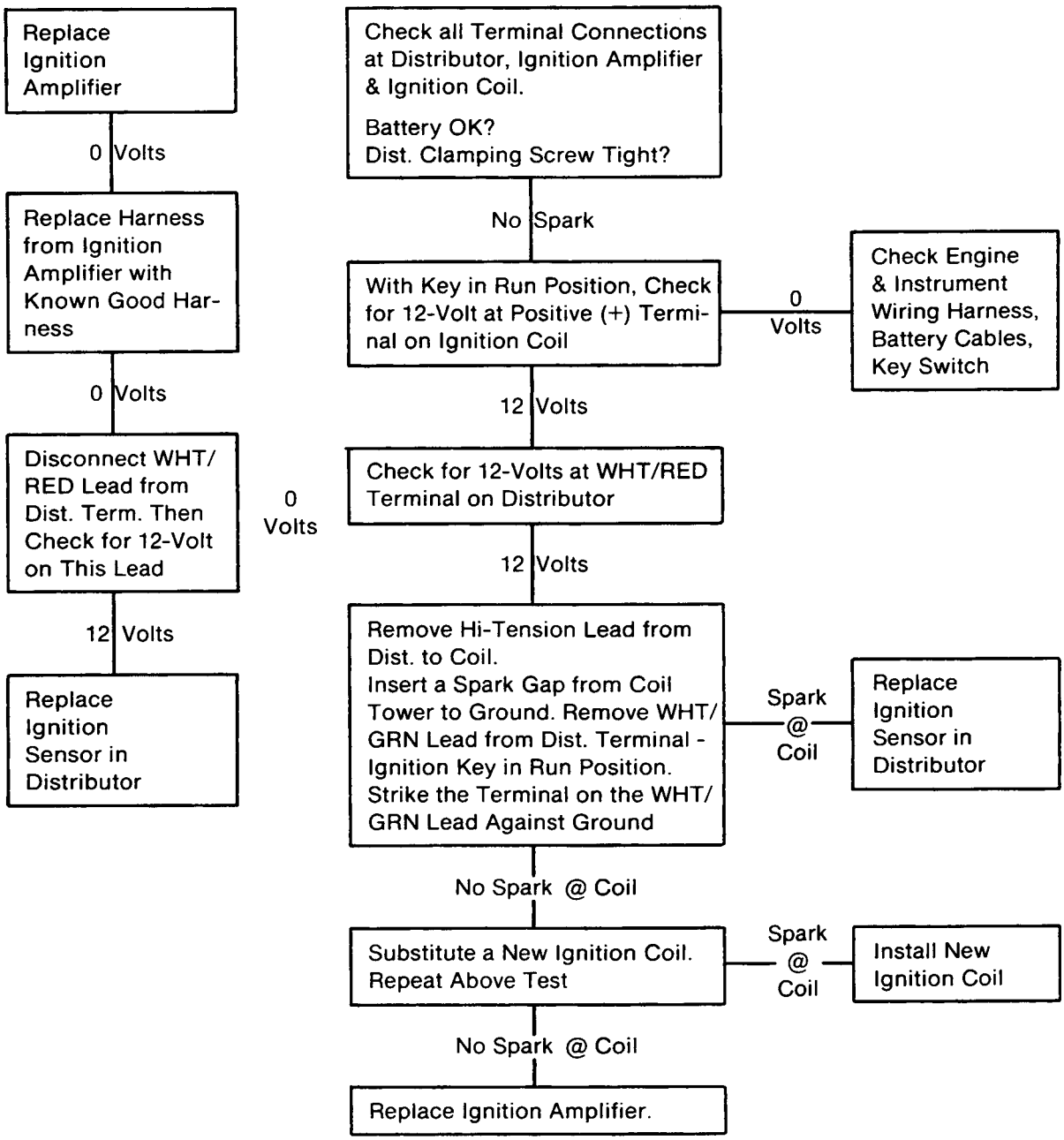


a - Degree Marks
b - Timing Mark

5. Adjust timing by loosening distributor clamp and rotating distributor body as required until timing mark on balancer or pulley lines up the mark on tab specfied in "Specifications." Tighten clamp and recheck location of timing mark.
6. Stop engine and remove timing light.

Testing Thunderbolt IV HEI Ignition System

⚠WARNING
Be sure that engine compartment is well ventilated and that there are no gasoline vapors present during the following test - to prevent a potential fire hazard.



NOTE: This system produces 35,000 volts at spark plug.

Prestolite Distributor System

Torque Specifications

FASTENER LOCATION	LB. FT. (N·m)
Distributor Clamp 3/8-16	20 (27)
Spark Plugs (14mm)	15 (20)

Tools/Lubricants/Sealants

TOOLS	
91-59339	Dwell Meter
91-76032	Magneto Analyzer
91-52024A1	Remote Starter Switch
91-99379	Timing Light
91-99750	Volt/Ohm Meter

TOOLS OBTAINED LOCALLY
Spring Tension Gauge

SEALANTS	
92-25711	Quicksilver Liquid Neoprene

LUBRICANT OBTAINED LOCALLY
Distributor Cam Lubricant

Specifications

UNIT OF MEASUREMENT
in. (mm)

Distributor

MODEL	MIE 5.7L SKI
Condenser*	.21 - .25 MFD.
Point Dwell	26° - 32°
Point Gap	.016 (0.4)
Point Spring Tension	17 - 21.5 oz. (482 - 610g)

NOTE: *Use Magneto Analyzer

Coil

Coil Part No.	32193
Max. Operating Amps*	1.1
Primary Resistance*	1.1 - 1.5 ohms
Secondary Resistance*	9,500 - 15,000 ohms
Secondary Continuity*	60 - 70
Resistor Wire*	1.8 - 2 ohms

NOTE: *Use Magneto Analyzer

Spark Plugs

MODEL	MIE 5.7L SKI
Plug Gap	.035 (0.9)
Plug Type	AC-MR43T/Champion RV8C NGK-BR6FS

Prestolite Distributor System

Torque Specifications

FASTENER LOCATION	LB. FT. (N·m)
Distributor Clamp 3/8-16	20 (27)
Spark Plugs (14mm)	15 (20)

Tools/Lubricants/Sealants

TOOLS	
91-59339	Dwell Meter
91-76032	Magneto Analyzer
91-52024A1	Remote Starter Switch
91-99379	Timing Light
91-99750	Volt/Ohm Meter

TOOLS OBTAINED LOCALLY
Spring Tension Gauge

SEALANTS	
92-25711	Quicksilver Liquid Neoprene

LUBRICANT OBTAINED LOCALLY
Distributor Cam Lubricant

Specifications

UNIT OF MEASUREMENT
in. (mm)

Distributor

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NOTE: *Use Magneto Analyzer

Spark Plugs

MODEL	MIE 5.7L SKI
Plug Gap	.035 (0.9)
Plug Type	AC-MR43T/Champion RV8C NGK-BR6FS

Repair

Precautions

⚠WARNING

When performing the following procedure, be sure to observe the following.

Be sure that engine compartment is well ventilated and that no gasoline vapors are present, to avoid the possibility of fire.

Be sure to keep hands, feet, and clothing clear of moving parts.

Do not touch or disconnect any ignition system parts while engine is running.

Do not reverse battery cable connections. System is negative (-) ground.

Do not disconnect battery cables while engine is running.

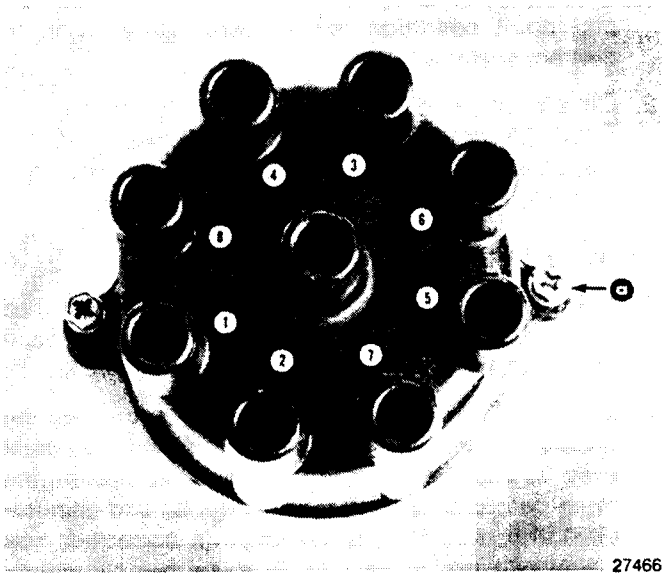
Distributor Cap and Rotor

1. Loosen distributor cap clamp retaining screws.
2. Remove distributor cap.
3. Clean cap with warm soap and water and blow off with compressed air.
4. Check cap contact for excessive burning or corrosion. Check center contact for deterioration.

IMPORTANT: Distributor caps (for marine use) should have brass contacts, aluminum contacts should not be used.

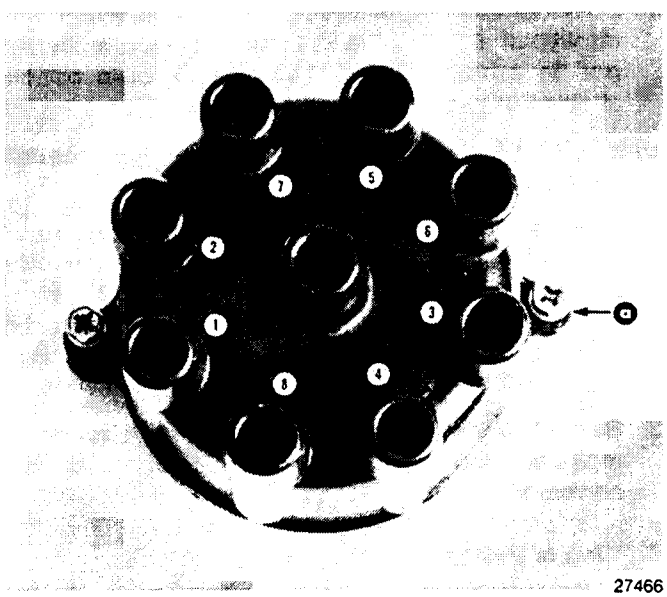
5. Check cap for cracks or carbon tracks using Magneto Analyzer.
6. Lift rotor up, off of distributor shaft.
7. Check for burned or corroded center contact.
8. Check rotor for cracks and carbon tracks using Magneto Analyzer.
9. Install rotor on shaft. Make sure to line up rotor with keyway on distributor shaft. Be sure rotor is completely seated on distributor shaft.
10. Place cap on distributor. Make sure notch on cap lines up with notch in distributor and cap is firmly seated.
11. Tighten clamp retaining screws.
12. Install spark plug wires (if removed) as shown.

Left Hand Rotation



a - Alignment Notch

Right Hand Rotation



a - Alignment Notch

Contact Points

1. Examine contact points for dirt, wear, pitting and misalignment. Dirty points should be cleaned. Normal point condition is an overall grey color on contact surface.
2. Check for point resistance. A voltage drop of less than .125 volts across points should exist. Make this check with a sensitive volt meter or point resistance meter.

Abnormal Point Wear

1. Points, which have been operated for a period of time, have a rough surface, but this may not mean that points are worn out.
2. If points burn or pit, however, they soon become unsatisfactory for further operation. Not only must they be replaced, but ignition system and engine must be checked to determine cause and elimination of trouble. Unless condition is corrected, new points will provide no better service than old points.

Cleaning of Points

1. Dirty contact points should be dressed with a few strokes of a clean, fine-cut contact file. File should not be used on other metals and should not be allowed to become greasy or dirty.

IMPORTANT: Never use emery cloth to clean contact points.

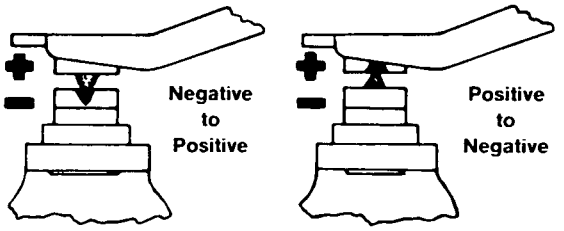
2. Contact surfaces, after considerable use, may not appear bright and smooth, but this is not necessarily an indication that they are not functioning satisfactorily. Do not attempt to remove all roughness nor dress point surfaces down smooth. Merely remove scale or dirt.
3. Badly burned or pitted contact points should be replaced and cause of trouble determined and corrected.

Burning of Points

1. Contact point burning results from high voltage, presence of oil or other foreign material, defective condenser or improper point adjustment.
2. High voltage causes excessively high current flow thru contact points which burns them rapidly. High voltage can result from improperly adjusted or inoperative voltage regulator.
3. Oil or crankcase vapors, which work up into distributor and deposit on point surfaces, cause them to burn rapidly.
4. If contact point opening is too small (cam angle too large), points will be closed too long. Average current flow thru points will be too high, so points will burn rapidly and arcing will occur between points.

Pitting of Points

1. Contact point pitting results from an out-of-balance condition in ignition system which causes transfer of material from one point to other so that a tip builds up on one point while a pit forms in other.



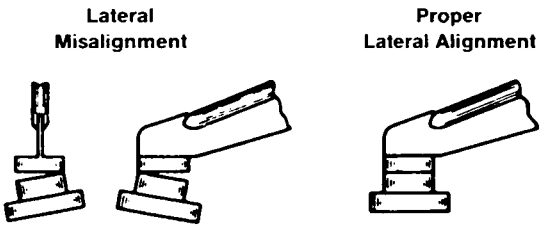
2. If points are pitted, condenser should be checked for proper capacity.

Replacement

1. Remove primary lead from primary terminal on distributor. Remove primary terminal screw and nut from distributor. (Use care not to lose the 2 insulator bushings in distributor housing.) Remove condenser lead and point lead from primary terminal screw.
2. Remove contact set attaching screw and lift contact point set from breaker plate.
3. Clean oil and dirt from breaker plate.

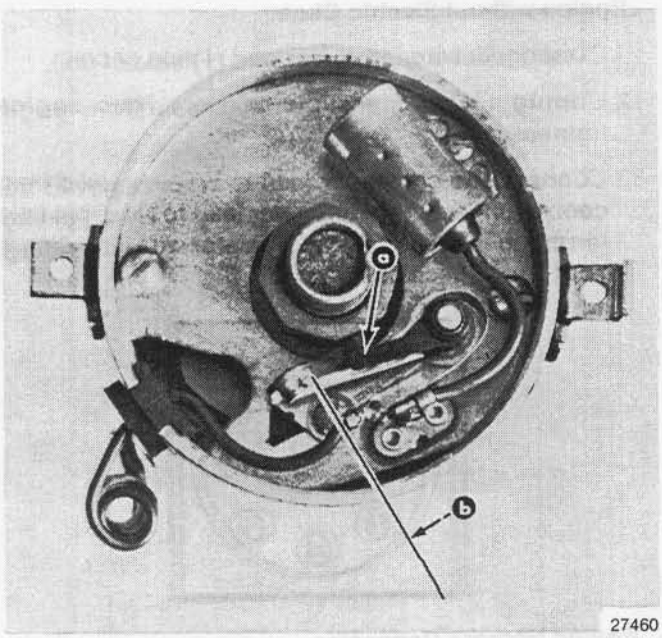
IMPORTANT: Carefully wipe protective film from point set prior to installation.

4. Place a small amount of Distributor Cam Lubricant on distributor cam.
5. Place a new contact point assembly in position on breaker plate and install attaching screw.
6. Place primary terminal screw through condenser lead and point lead. Install primary screw through 2 insulator bushings in distributor housing. Install primary terminal lock nut, primary lead, and primary lead retaining nut to primary terminal screw.
7. Check points for proper alignment. If points do not align properly, replace with another set of points.



8. Check point spring tension.

Contact point spring tension must fall within specified limits. Weak tension will cause chatter which results in arcing and burning of points and an ignition miss at high speed, while excessive tension will cause undue wear of contact points, cam and rubbing block. Contact point tension should be checked with a spring gauge. Scale should be hooked to breaker lever and pull exerted at 90° to breaker lever. Reading should be taken just as points separate. Tension can be adjusted by bending breaker lever spring. If tension is excessive, it can be decreased by pinching spring carefully. To increase tension remove lever from distributor so that spring can be bent away from lever. Avoid excessive spring distortion.



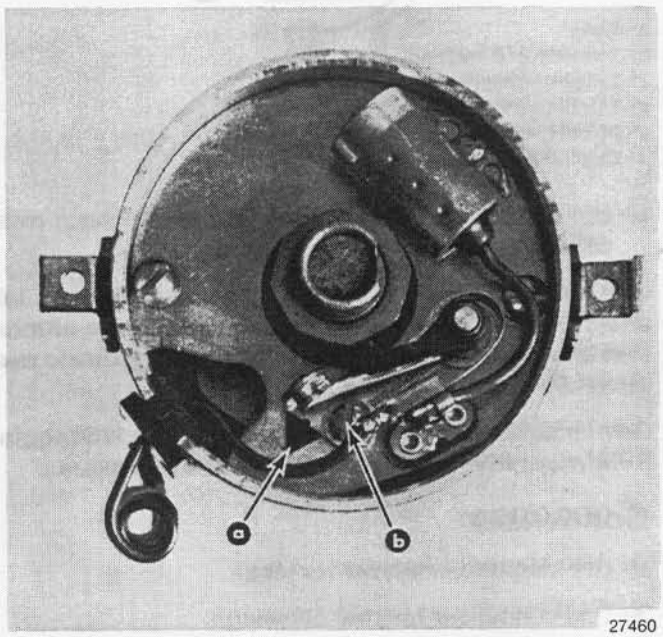
27460

a - Movable Contact
b - Spring Tension Gauge

Point Adjustment with Feeler Gauge

IMPORTANT: Point gap (dwell) can be adjusted by 2 methods. It is preferred that points be adjusted with a feeler gauge, then checked with a dwell meter. Points, however, also can be adjusted, as well as checked, with a dwell meter: After points have been set, dwell should be checked with engine running.

1. Rotate distributor until rubbing block rests on peak of cam lobe, which will provide maximum breaker point opening.
2. Insert correct feeler gauge between breaker points.
3. Loosen lockscrew and adjust points to specifications.



27460

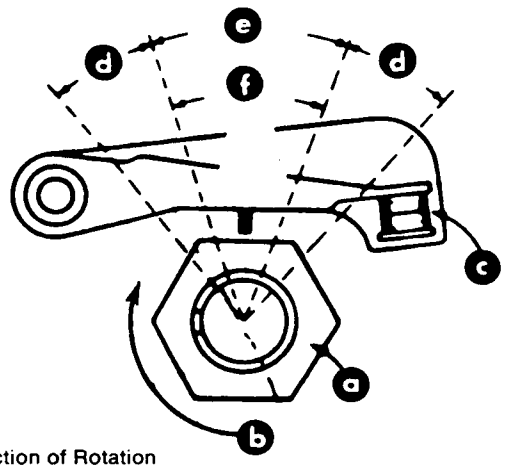
a - Screwdriver Adjustment Slot
b - Locking Screw

Point Adjustment

Dwell Adjustment

1. Remove distributor cap and rotor.
2. Connect positive (+) dwell meter lead to negative (-) side of coil. Connect negative (-) meter lead to ground.
3. Loosen point lock screw slightly.
4. While cranking engine with starter, adjust dwell with a screwdriver to obtain reading on dwell meter, as specified in "Specifications," and tighten lockscrew. (Dwell reading will be unsteady using this method.)

IMPORTANT: Cam angle increased as point opening is decreased and vice versa.



a - Cam
b - Direction of Rotation
c - Breaker Points
d - Points Open
e - Points Close
f - Cam Angle or Dwell

5. Install rotor and distributor cap and recheck dwell with engine running.

IMPORTANT: Dwell should be checked between idle and 1750 RPM. Any dwell reading variations of more than 3° between idle and 1750 RPM would indicate wear in the distributor.

Cam angle readings, taken at speeds above 1750 engine RPM, may prove unreliable on some dwell meters.

Condenser

1. Use Magneto Analyzer for test.
2. Test condenser for the following:
   a. Condenser capacity test.
   b. Condenser leakage and short test.
   c. Coil continuity test.
   d. Primary resistance test.
   e. Secondary resistance test.
3. Replace coil if test results are not within specfications.

Coil

1. Use Magneto Analyzer for test.
2. Check coil for the following:
   a. Coil power test.
   b. Coil surface insulation test.
   c. Coil continuity test.
   d. Primary resistance test.
   e. Secondary resistance test.
3. Replace coil if test results are not within specfications.

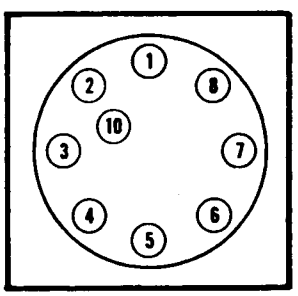
Ignition Resistance Wire

Engine with Electric Choke

1. Disconnect wire from positive (+) side of coil.
2. Unplug quick disconnect (with 2 wires) from electric choke heater element.
3. Connect ohmmeter leads to ends of disconnected wires. Replace resistor wire if reading is not within specifications.
4. Reconnect wires to coil and choke.
5. For instructions on replacing resistor wire refer to "Section 3, Part E."

Engine without Electric Choke

1. Disconnect wire from positive (+) side of coil.
2. Unplug instrumentation harness from engine harness.
3. Connect one ohmmeter lead to wire removed from coil. Connect other ohmmeter lead to No. 5 pin hole in engine harness. Replace resistor wire if reading is not within specifications.



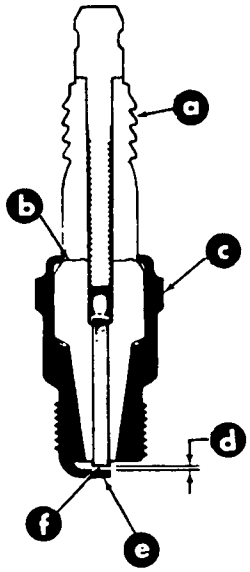
Engine Harness Connector

4. Reconnect wire to coil. Plug instrumentation harness onto engine harness and tighten retaining clamp securely.
5. For instructions on replacing resistor wire refer to "Section 3, Part E."

Spark Plugs

1. Inspect each plug individually for badly worn electrodes, glazed, broken or blistered porcelain and replace where necessary.
2. Inspect each spark plug for make and heat range. All plugs must be the same make and number or heat range. Refer to "Specifications" for spark plug numbers.

3. Adjust spark plug gaps with a round feeler gauge. Refer to "Specifications" for proper spark plug gap.



a - Porcelain Insulator
b - Insulator Cracks Often Occur at this Point
c - Shell
d - Proper Gap
e - Side Electrode (Bend to Adjust Gap)
f - Center Electrode (File Flat When Adjusting Gap)

4. Clean spark plug seating area. DO NOT use gaskets on taper seat plugs. Install spark plugs and torque to specifications. Where used, gasket must be fully compressed to complete heat transfer and provide a gas-tight seal in cylinder. For this reason, as well as necessity of maintaining correct plug gap, correct torque is very important during installation.

IMPORTANT: Tapered seat spark plugs are not interchangeable with nontapered (with gasket) spark plugs.

High Tension Leads

1. Inspect high tension leads for damage.
2. Check high tension leads for continuity.
3. Replace any leads that are cracked, cut, or have damaged spark plug boots.
4. Replace any leads that do not show continuity from end to end.
5. Reinstall high tension leads in proper order.

IMPORTANT: Proper positioning in high tension lead supports is important to prevent cross firing.

Distributor Repair

Removal

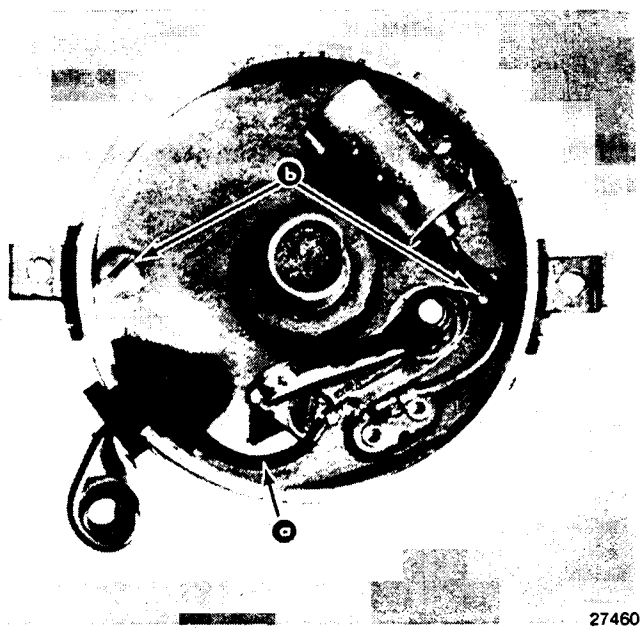
1. Remove distributor cap (2 screws) and gasket. Do not remove plug wires from cap unless necessary.
2. Disconnect coil primary lead from distributor.
3. Crank or turn engine slowly. Align timing marks when rotor is pointing to No. 1 terminal of distributor cap. If same distributor is to be reinstalled in engine, mark position of distributor housing in relation to engine so that distributor may be installed in same position.
4. Remove distributor retaining clamp.
5. Remove distributor.

IMPORTANT: To simplify distributor installation, do not turn crankshaft with distributor removed from engine.

Disassembly

IMPORTANT: It is not necessary to disassemble distributor any further than required to complete repairs.

1. Lift rotor off of distributor shaft.
2. Remove condenser and breaker points and test as previously outlined.
3. Mark breaker plate location and remove 2 retaining screws. Remove breaker plate.



a - Primary Lead
b - Breaker Plate Attaching Screws

4. Remove pin from driven gear and shaft and remove gear from shaft.
5. Remove washer(s) from shaft. (If there are 2 washers, the steel washer goes towards housing and the brass washer towards gear.)

IMPORTANT: Housing bushings are not serviced separately. (Refer to parts manual.)

6. Check for side play between shaft and housing bushings. Maximum side play is .002 in. (.05mm).
7. Remove and check shaft for being bent by placing in V-blocks and checking run out with a dial indicator. Maximum run out allowed is .002 in. (.05mm) (retain washer between advance mechanism and distributor housing).
8. Check cam lobes for wear and cam should fit tight on shaft. Advance plate should fit tight on shaft.

IMPORTANT: Shaft, advance mechanism and cam are serviced as an assembly and should not be disassembled. (Refer to parts manual.)

9. Check advance mechanism for free movement. Mechanism should return freely when released.

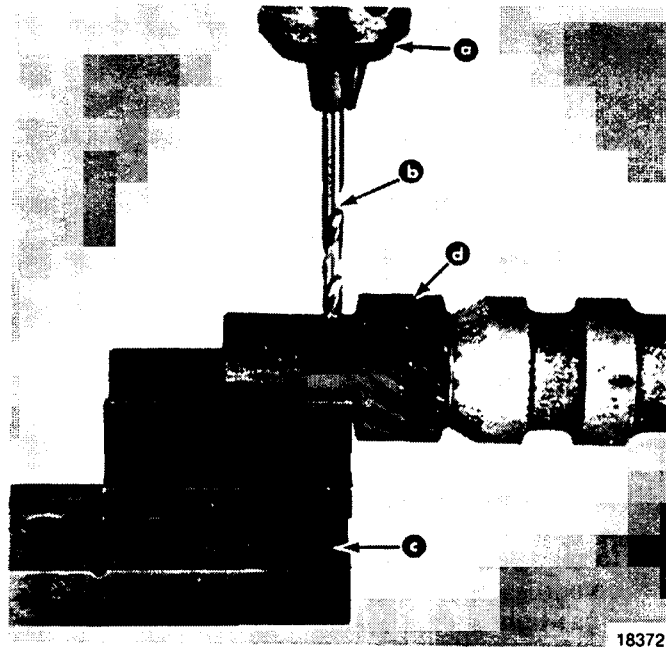
Reassembly

1. Install washer on shaft assembly and lubricate shaft with engine oil. Install shaft in housing.
2. Install washer(s) on shaft between housing and gear (if there are 2 washers, steel goes toward housing and brass goes toward gear).
3. If installing original driven gear slide onto shaft and install roll pin.

IMPORTANT: Hole in gear is offset, gear will fit on shaft and line up with hole only one way.

4. If installing a new driven gear the gear will not come drilled all the way through. Install gear on shaft. Turn gear to line up the hole with the hole in shaft. Using hole in gear and hole in shaft as a guide, drill through other side of gear with a 3/16 in. carbide tipped drill, install roll pin.

IMPORTANT: If new gear has only a dimple, you will have to drill through one side of the gear before you slide gear onto shaft. In most cases it is recommended to have a machine shop complete the drilling operation for new gear installation.



a - Drill Press
b - 3/16 in. Carbide Tip Drill
c - V-Block
d - New Gear

5. Install breaker plate using alignment mark to properly locate.
6. Install points, condensor, and primary terminal screw.
7. Install distributor as outlined in "Distributor Installation".

Distributor Installation

Engine Not Disturbed

1. Install new gasket on distributor housing.
2. Turn rotor approximately 1/8-turn in a counterclockwise direction past mark previously scratched on distributor housing.
3. Work distributor down into position in engine block with distributor positioned as noted during removal.

IMPORTANT: It may be necessary to move rotor slightly to start gear into mesh with camshaft gear, but rotor should line up with the mark when distributor is down in place. Distributor shaft must enter oil pump shaft for complete installation.

4. Replace and tighten distributor hold-down bolt and clamp. Connect primary lead to coil. Also install spark plug and coil secondary wires, if removed.

IMPORTANT: Wires must be installed in supports, to prevent cross-firing. Refer to "Specifications," for firing order.

5. Set point gap and dwell.
6. Install rotor and cap.
7. Time ignition as outlined under "Ignition Timing."

Engine Disturbed

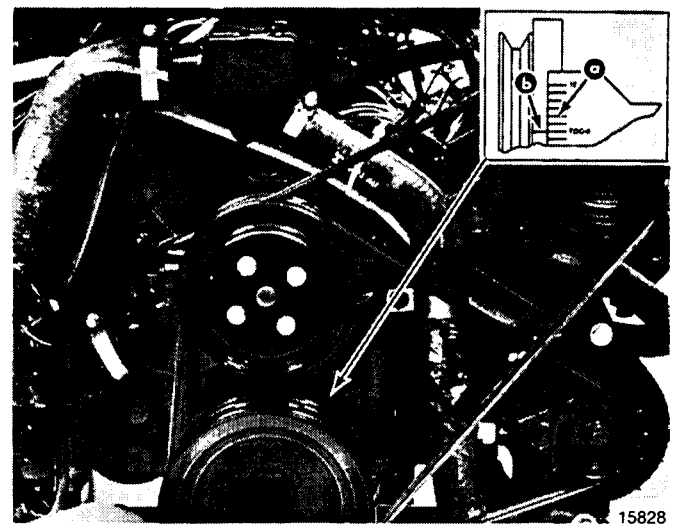
1. Locate No. 1 piston in firing position by either of 2 methods.
   a. Remove No. 1 spark plug and, with finger on plug hole, crank engine until compression is felt in No. 1 cylinder. Continue cranking until pointer lines up with timing mark on crankshaft pulley or . . .
   b. Remove rocker cover and crank engine until No. 1 intake valve closes, continuing to crank slowly until pointer lines up with timing mark on crankshaft pulley.
2. Position distributor to opening in block in normal installed attitude.
3. Position rotor to point toward No. 1 cylinder on cap (with distributor housing held in installed attitude), then turn rotor counterclockwise approximately 1/8-turn more and push distributor down to engage camshaft. It may be necessary to rotate rotor slightly until camshaft engagement is felt.
4. While pressing down firmly on distributor housing, engage starter a few times to make sure oil pump shaft is engaged. Install hold-down clamp and bolt and snug up bolt.
5. Turn distributor body slightly until points just open and tighten distributor clamp bolt.
6. Place distributor cap in position and check that rotor lines up with terminal for No. 1 spark plug.
7. Install cap, distributor primary lead to coil. Check all high tension wire connections and connect spark plug wires, if they have been removed. Wires must be installed in their proper location in supports to prevent cross-firing. Refer to "Specifications" for firing order.
8. Set point gap and dwell.
9. Time ignition as outlined under "Ignition Timing."

Ignition Timing

IMPORTANT: Dwell must be set to specification before adjusting timing.

1. Connect timing light to No. 1 spark plug. Connect power supply leads on light to battery (12 volts). Refer to "Specification" for cylinder numbering and location.
2. Connect tachometer to engine.
3. Start engine and run at normal idle speed.
4. Aim timing light at timing tab, located on timing gear cover and crankshaft harmonic balancer.

IMPORTANT: GM engine timing marks (on tab) are in 2° increments. MCM and MIE L.H. engines will have the "A" (Advance) mark to the left of "O." MIE R.H. engines will have the "A" mark to the right of "O." Timing must be set on the "A" side of "O" (Top Dead Center).

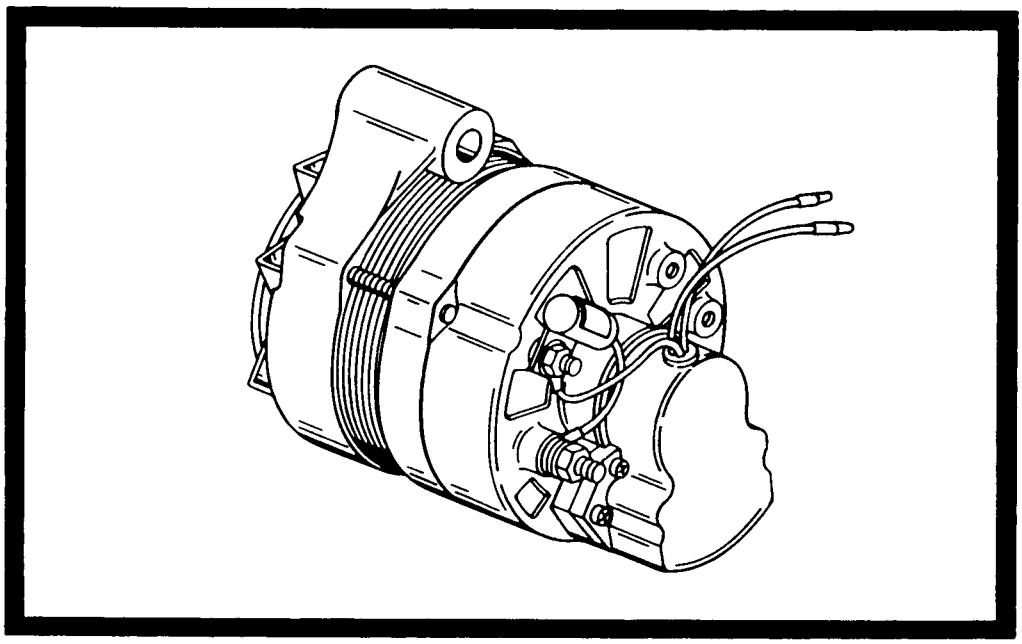


a - Degree Marks
b - Timing Marks

Timing Tab on "GM" V-8 Engine

5. Adjust timing by loosening distributor clamp and rotating distributor body as required until timing mark on balancer or pulley lines up with mark on tab specified in "Specifications." Tighten clamp and recheck location of timing mark.
6. Stop engine and remove timing light.

ELECTRICAL SYSTEMS



4

C

CHARGING SYSTEMS

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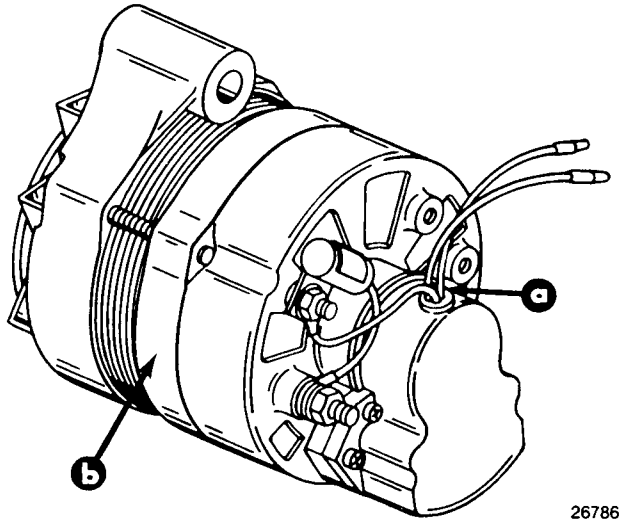
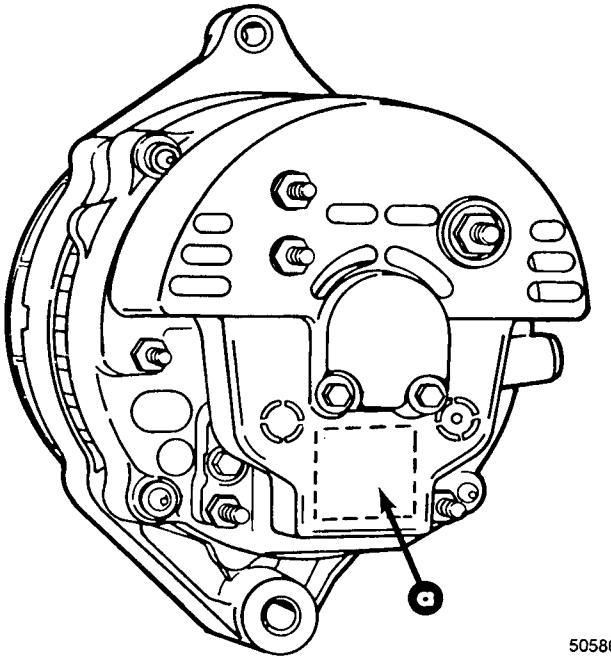
Identification



26786

a - 2 Wires Going to Engine Harness Coming Out the Top of Regulator
b - Mando Number

Mando



50580

a - Prestolite Number

Prestolite

Replacement Parts Warning

⚠WARNING

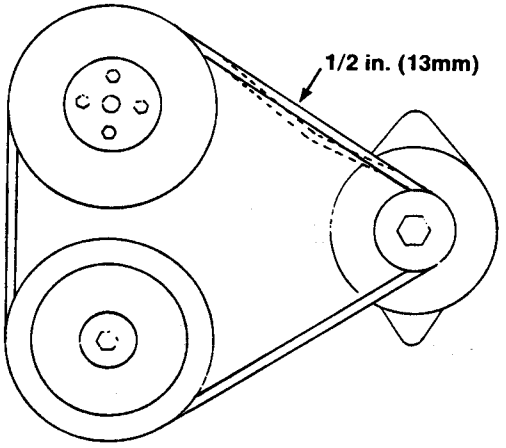
Electrical, ignition and fuel system components on your MerCruiser are designed and manufactured to comply with U.S. Coast Guard Rules and Regulations to minimize risks of fire and explosion.

Use of replacement electrical, ignition or fuel system components, which do not comply with these rules and regulations, could result in a fire or explosion hazard and should be avoided.

Drive Belt Tension Adjustment

Alternator

1. Install drive belt on pulleys and adjust tension as follows:
   a. Pivot alternator away from engine, as required, until correct tension is obtained as shown.
   b. After obtaining correct tension, securely retighten alternator brace attaching bolts and alternator mounting bolts.



Alternator Drive Belt Tension

2. If a new drive belt has been installed, recheck belt tension after running for 5 minutes.

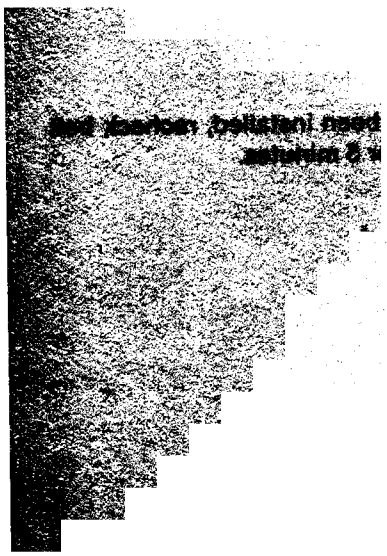
Battery Isolators

Dual Battery Charging Systems Using A Battery Isolator

Battery isolators allow the addition of an auxiliary (second) battery to the MerCruiser electrical system. The auxiliary battery is primarily used as a power source for various accessories installed on the boat. The battery isolator will allow the alternator to charge both the cranking and auxiliary batteries at the same time while preventing accessories, connected to the auxiliary battery, from drawing power from the cranking battery.

Mercury Marine does not manufacture any battery isolator systems. Battery isolators must be bought from an outside manufacturer. Mercury Marine suggests following the manufacturer's instruction carefully.

IMPORTANT: Alternators used on MerCruiser engines ARE NOT equipped with an isolation diode.

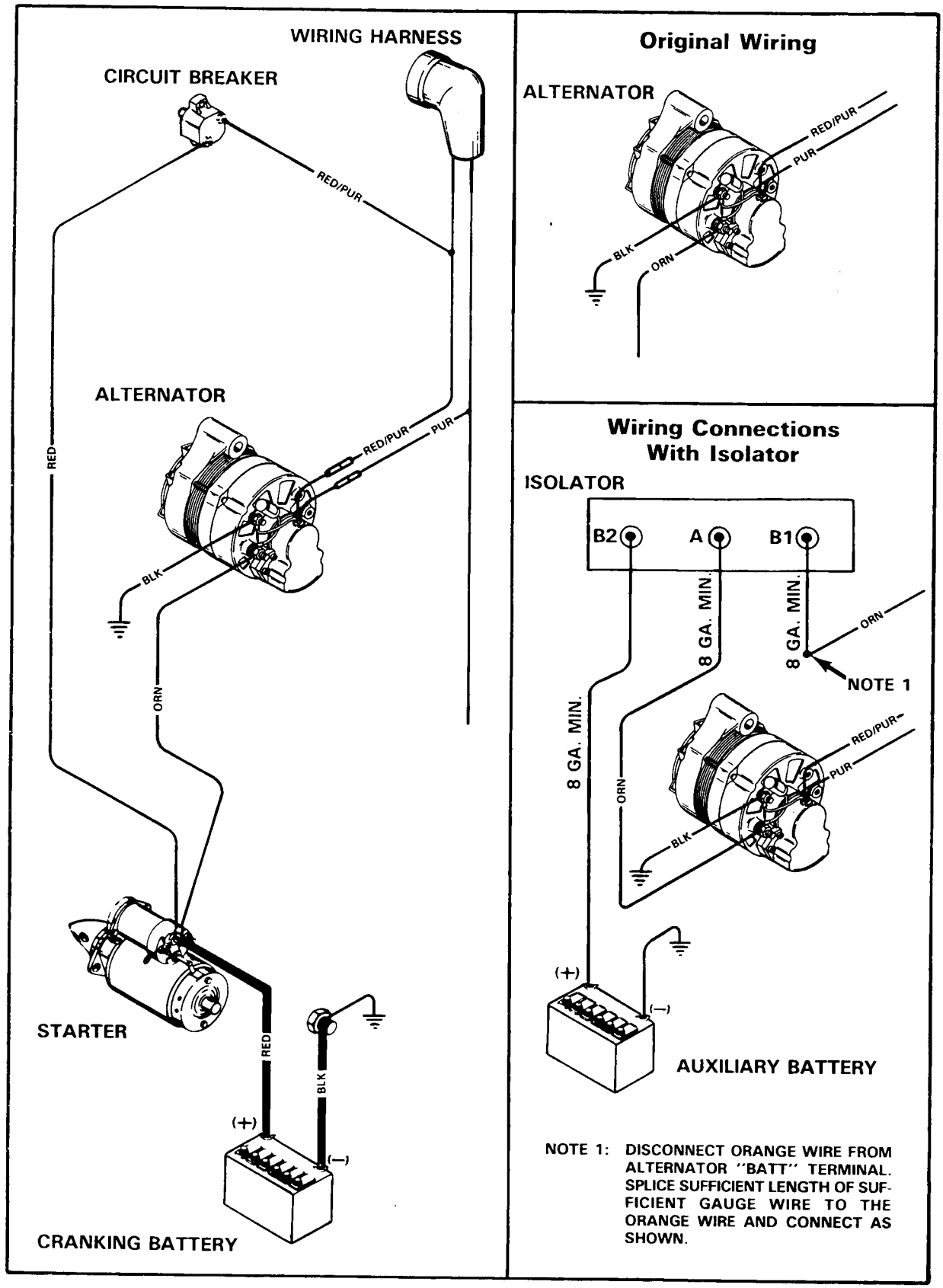


⚠CAUTION

Follow battery isolator manufacturer's instructions for wire gauge. Battery isolator installation must conform to BIA Low Voltage Wiring Standard No. 125-79.

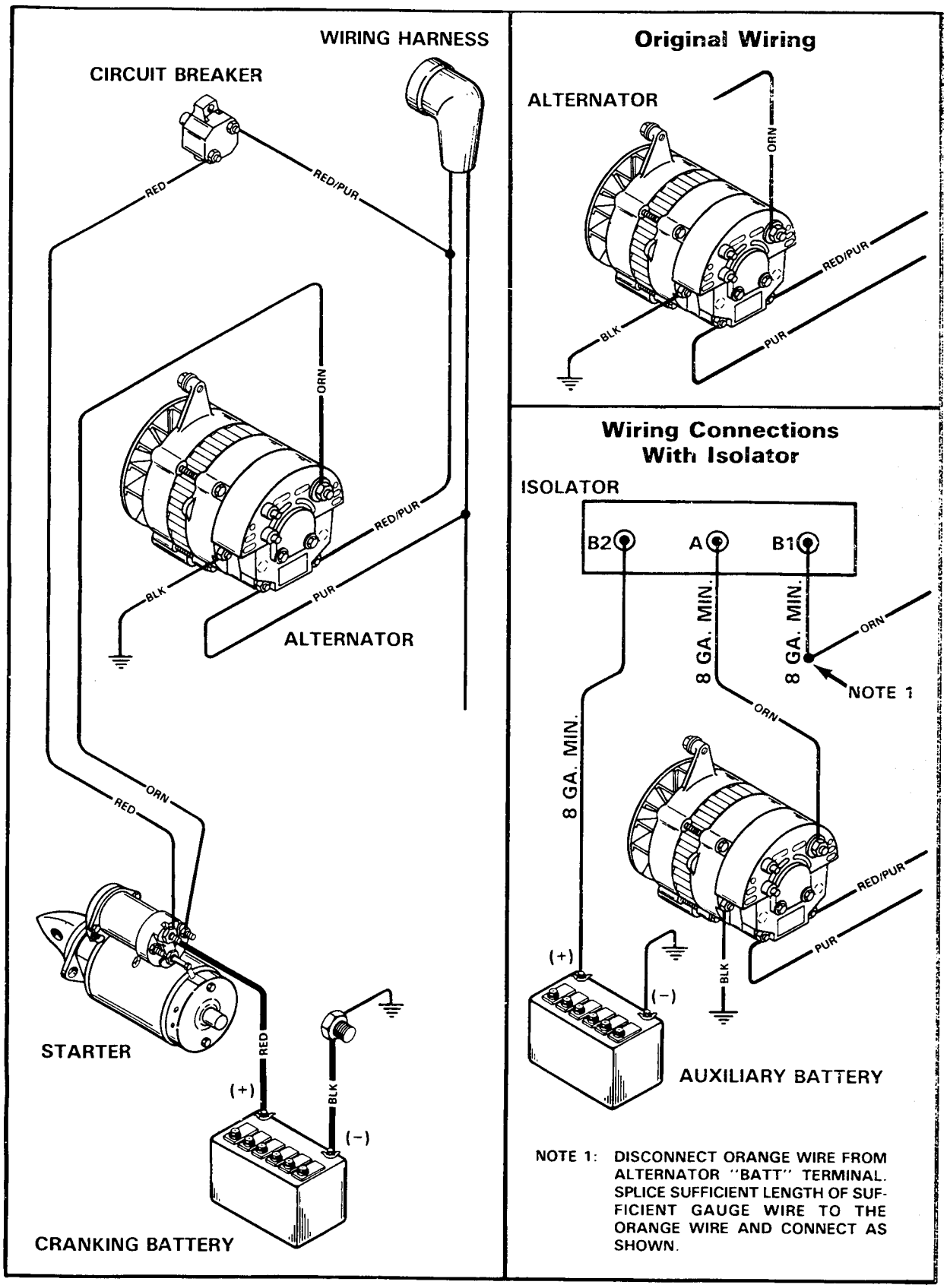
NOTE: MerCruiser engines equipped with a 3-wire, belt driven alternator, can use a battery isolator.

BLK = BLACK
BLU = BLUE
BRN = BROWN
GRY = GRAY
GRN = GREEN
ORN = ORANGE
PNK = PINK
PUR = PURPLE
RED = RED
TAN = TAN
WHT = WHITE
YEL = YELLOW
LIT = LIGHT
DRK = DARK



50700

Mando Alternator with Voltmeter Circuit (Typical Wiring Shown)



Prestolite Alternator with Voltmeter Circuit (Typical Wiring Shown)

Mando Alternator

Specifications

Excitation Circuit	1.3 to 2.5 Volts
Current Output	50 Amp. Min.
Voltage Output	13.9 to 14.7 Volts
Condenser Capacity	.5 MFD

Tools/Sealants

MERCURY MARINE SPECIAL TOOLS	
91-31229A5	Bearing Removal and Installation Kit
91-76032	Magneto Analyzer
91-37241	Universal Puller Plate
91-99750	Multi-Meter/DVA Tester

TOOLS PURCHASED LOCALLY
Ammeter (0-50 Amps)

SEALANTS	
92-25711	Quicksilver Liquid Neoprene

Torque Specifications

FASTENER LOCATION	LB. FT. (N·m)	LB. IN. (N·m)
End Frame Screws		50-60 (6-7)
Brush Set Screws		16-20 (1-2)
Regulator Mounting Screws		40-45 (4-5)
Regulator Leads		20-30 (2-3)
Ground Terminal Nut		20-30 (2-3)
Pulley Nut	35-50 (48-68)	
Alternator Brace to Alternator		192 (28)
Alternator Brace to Block	30 (41)	
Alternator to Mounting Bracket	35 (48)	
Alternator Mounting Bracket	30 (41)	
V-Belt Tension (Note 1)	Depress 1/2 in.	

NOTE 1: Depress Belt with Thumb at Midway Point between Circulating Pump Pulley and Alternator.

Description

The alternator employs a rotor, which is supported in 2 end frames by ball bearings, and is driven (via a pulley) at approximately twice engine speed. The rotor contains a field winding that is enclosed between 2 multiple-finger pole pieces. The ends of the field winding are connected to 2 brushes (mounted in the rear end frame) which make continuous sliding (or slipping) contact with the slip rings. The current (flowing through the field winding) creates a magnetic field that causes the adjacent fingers of the pole pieces to become alternate north and south magnetic poles.

A 3-phase stator is mounted directly over the rotor pole pieces and between the 2 end frames. It consists of 3 windings wound 120° electrically out-of-phase on the inside of a laminated core. The windings are all connected together on one end, while the other ends are connected to a full-wave rectifier bridge.

The rectifier bridge contains 6 diodes which are arranged so that current flows from ground, thru the stator and to the output terminal, but not in the opposite direction.

When current is supplied to the rotor field winding, and the rotor is turned, the movement of the magnetic fields created induces an alternating current into the stator

When current is supplied to the rotor field winding, and the rotor is turned, the movement of the magnetic fields created induces an alternating current into the stator windings. The rectifier bridge then changes this alternating current to direct current which appears at the output terminal. A diode trio also is connected to the stator windings to supply current to the regulator and the rotor field during operation.

Voltage output of the alternator is controlled by regulating the current supplied to the rotor field. This is accomplished by a transistorized voltage regulator that senses the voltage at the battery and regulates the field current to maintain alternator voltage within prescribed limits for properly charging the battery. Current output of the alternator does not require regulation, as maximum current output is self-limited by the design of the alternator. As long as the voltage is regulated within the prescribed limits, the alternator cannot produce excessive current. A cutout relay in the voltage regulator also is not required, as the rectifier diodes (which allow current to flow in one direction only) prevent the battery from discharging back through the stator.

Due to the lack of residual magnetism in the rotor pole pieces, a small amount of current must be supplied to the rotor field to initially start the alternator charging. This is accomplished by means of an excitation circuit in the regulator which is connected to the ignition switch. Once the alternator begins to produce output, field current is supplied solely by the diode trio, as explained, preceding.

The alternator also is equipped with a fan (mounted on the rotor shaft) which induces air flow through the alternator to remove the heat created by the rectifier and stator. A capacitor also is utilized to protect the rectifier system from high voltages and to suppress radio noise.

Precautions

The following precautions MUST BE observed when working on the alternator system. Failure to observe these precautions may result in serious damage to the alternator or alternator system.

1. DO NOT attempt to polarize the alternator.
2. DO NOT short across or ground any of the terminals on the alternator, except as specifically instructed in the "Troubleshooting Tests."
3. NEVER disconnect the alternator output lead or battery cables when the alternator is being driven by the engine.
4. NEVER disconnect regulator lead from alternator regulator terminal when the alternator is being driven by the engine.
5. ALWAYS remove negative (-) battery cable from battery before working on alternator system.
6. When installing battery, BE SURE to connect the negative (-) (grounded) battery cable to negative (-) battery terminal and the positive (+) battery cable to positive (+) battery terminal.
7. If a charger or booster battery is to be used. BE SURE to connect it in parallel with existing battery (positive to positive; negative to negative).

Periodic Maintenance

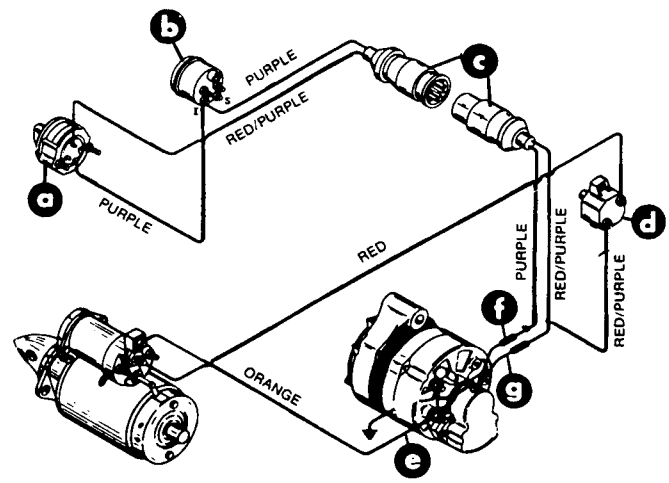
The following maintenance check should be performed every 50 hours or 60 days (whichever comes first) in fresh water areas or every 25 hours or 30 days in salt water areas.

⚠CAUTION
Remove all battery cables from battery (before conducting the following check) to prevent accidentally shorting out electrical system.

1. Inspect entire alternator system for corroded or loose connections.
2. Check wiring for frayed or worn insulation.
3. Check alternator drive belt for excessive wear, cracks, fraying and glazed surfaces. Also, check drive belt tension and adjust, if necessary, as explained under "Drive Belt Tension Adjustment."
4. Check alternator mounting bolts for adequate tightness.
5. Inspect slip ring end frame flame arrestor screen for debris and clean, if necessary, using compressed air or a cloth. Screen MUST BE clean, or alternator may overheat.

System Components

The alternator system, used on engines with Mando Alternators consists of the alternator, battery, the ignition switch and the wiring which connects these components.



a - Ignition Switch
b - Battery Meter
c - Harness Plug
d - Circuit Breaker
e - Output Lead
f - Excitation Lead
g - Sensing Lead

Troubleshooting Tests (Alternator on Engine)

Use the following tests in conjunction with the "Troubleshooting" in Section 1. Before proceeding with the tests, however, perform the following checks to eliminate possible problem areas. Also observe "Precautions," immediately preceding, to prevent damage to alternator system.

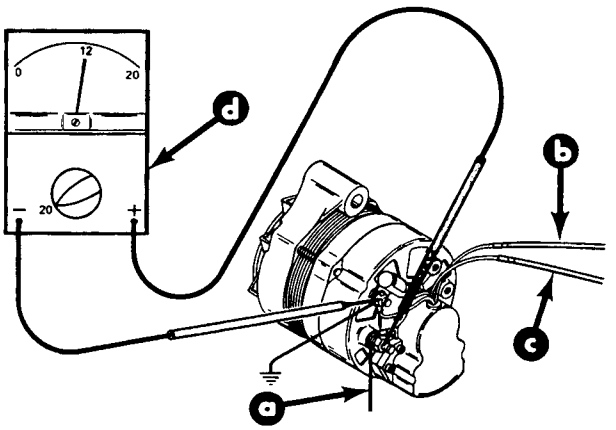
1. If problem is an undercharged battery, check to ensure that undercharged condition has not been caused by excessive accessory current draw or by accessories which have accidentally been left on. Also, check that undercharged condition has not been caused by running engine at too low a speed for extended periods of time.
2. Check physical condition and state of charge of battery, as outlined in "Storage Battery" in "Section 4 Part A." Battery MUST BE at least 75% (1.230 specific gravity) of fully charged to obtain valid results in the following tests. If not, charge battery before testing system.
3. Inspect entire alternator system wiring for defects. Check all connections for tightness and cleanliness, particularly battery cable clamps and battery terminals.
4. Check alternator drive belt for excessive wear, cracks, fraying and glazed surfaces and replace if necessary. Also, check drive belt tension and adjust if necessary, as outlined under "Drive Belt Replacement and Tension Adjustment."

Circuitry Test

Perform the following tests, using a 0-20 volt DC voltmeter, to check that all of the circuits between the alternator and the other components within the alternator system are in good condition.

OUTPUT CIRCUIT

1. Connect positive voltmeter lead to alternator output terminal and negative lead to a ground terminal on alternator.
2. Wiggle engine wiring harness while observing voltmeter. Meter should indicate approximate battery voltage and should not vary. If no reading is obtained, or if reading varies, check alternator output circuit for loose or dirty connections or damaged wiring.

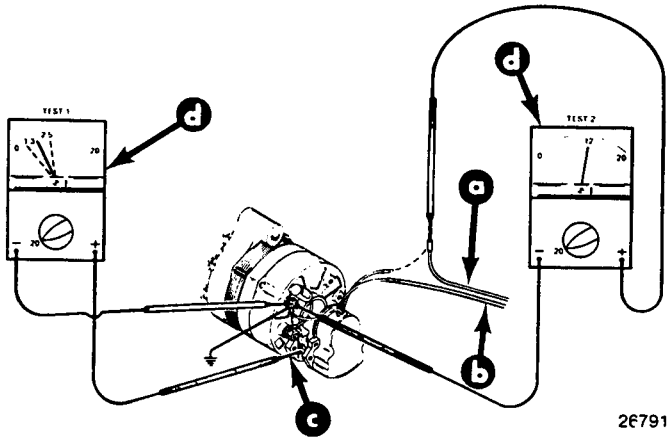


a - Output Wire - Orange
b - Excitation Wire - Purple
c - Sensing Wire - Red/Purple
d - Volt Meter (0-20 Volts)

Alternator Output Circuit Test

EXCITATION CIRCUIT

1. Remove 4 screws which secure the regulator to the alternator.
2. Connect positive (+) voltmeter lead to regulator terminal (green wire) on alternator and negative (-) lead to a ground terminal on alternator. (Test No. 1)
3. Turn ignition switch to "On" position and note voltmeter reading. Reading should be 1.3 to 2.5 volts.
4. If no reading is obtained, an opening exists in alternator excitation lead or in excitation circuit of regulator. Unplug purple lead from regulator. Connect positive voltmeter lead to purple lead and negative voltmeter lead to ground. (Test No. 2) If voltmeter now indicates approximate battery voltage, voltage regulator is defective and must be replaced. If no voltage is indicated, check excitation circuit for loose or dirty connections or damaged wiring.
5. If reading is between .75 and 1.1 volts, rotor field circuit probably is shorted or grounded. Disassemble alternator and test rotor as outlined under "Alternator Repair," following.
6. If reading is between 6.0 and 7.0 volts, rotor field circuit probably is open. Remove regulator and inspect for worn brushes or dirty slip rings. Replace brushes if less than 1/4 in. (6mm) long. If brushes and slip rings are in good condition, disassemble

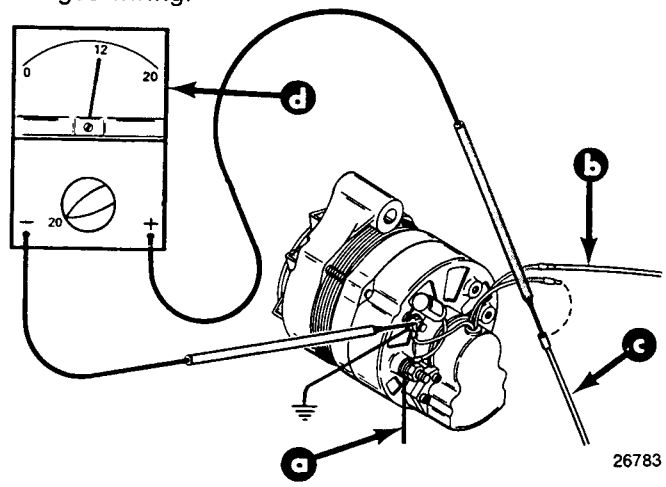


a - Excitation Wire - Purple
b - Sensing Wire - Red/Purple
c - Green Wire
d - Voltmeter (0-20 Volts)

Alternator Excitation Circuit Test

SENSING CIRCUIT

1. Unplug red/purple lead from voltage regulator.
2. Connect positive voltmeter lead to red/purple lead and negative voltmeter lead to ground terminal.
3. Voltmeter should indicate battery voltage. If battery voltage is not present, check sensing circuit (red/purple lead) for loose or dirty connection or damaged wiring.



a - Output Wire - Orange
b - Excitation Wire - Purple
c - Sensing Wire - Red-Purple
d - Volt Meter (0-20 Volts)

Regulator Sensing Circuit Test

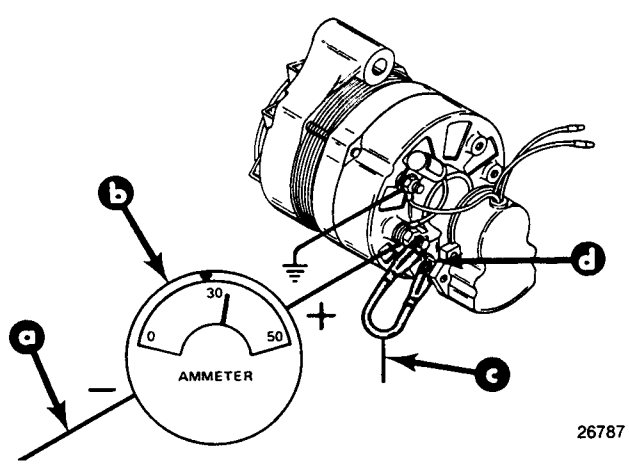
Current Output Test

Perform this test to check if alternator is capable of producing rated current output, using a 0-50 amp DC ammeter.

⚠WARNING

Be sure that engine compartment is well-ventilated and that there are no gasoline vapors present (during the test) to prevent the possibility of an explosion and/or a fire, should a spark occur.

1. Disconnect negative (-) battery cable from battery.
2. Disconnect orange lead from alternator output terminal and connect ammeter in series between lead and output terminal. Connect positive (+) side of ammeter toward output terminal.
3. Reconnect negative battery cable.
4. Remove coil hi-tension lead from distributor cap tower and ground it to block. Turn on all accessories and crank engine over with starter motor for 15-20 seconds.
5. Turn off accessories and reinstall coil hi-tension lead. Start engine and adjust engine speed to 1500-2000 RPM. Quickly observe ammeter. Reading should be at least 30 amps.
6. If reading is low, stop engine and connect a jumper wire between alternator output terminal and regulator terminal. Repeat Steps 4 and 5.
7. If reading is now within specifications, diode trio is faulty. Disassemble alternator and replace diode trio, as explained under "Alternator Repair," following.
8. If reading is still low with jumper wire connected, perform "Voltage Regulator Test," following, to determine if fault is in regulator or alternator.



a - Output Wire - Orange
b - Ammeter (0-50 Amps)
c - Jumper Lead
d - Regulator Terminal (Green Wire)

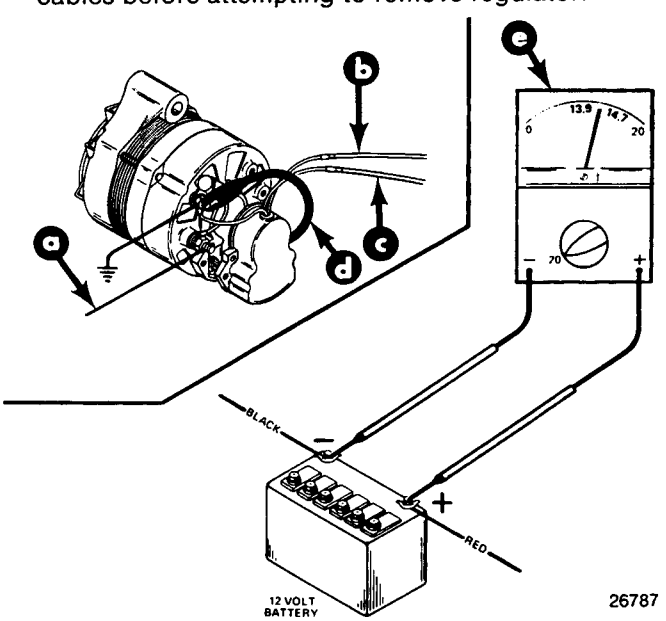
Alternator Current Output Test

Voltage Output Test

Perform this test to determine if voltage regulator is operating correctly, using a 0-20 volt DC voltmeter.

IMPORTANT: Battery MUST BE fully charged (1.260 or above specific gravity) to obtain proper voltage reading in this test. If necessary, charge battery with a battery charger or allow engine to run a sufficient length of time to fully charge battery before taking reading.

1. Connect positive (+) voltmeter lead to positive battery terminal and negative (-) voltmeter lead to negative terminal.
2. Start engine and run at fast idle until engine reaches normal operating temperature. Adjust engine speed to 1500-2000 RPM and observe voltmeter for highest reading. Reading should be between 13.9 and 14.7 volts.
3. If reading is high, check for a loose or dirty regulator ground lead connection. If connection is good (and sensing circuit checked out good in "Alternator System Circuitry Test"), voltage regulator is faulty and must be replaced. Be sure to disconnect battery cables before attempting to remove regulator.



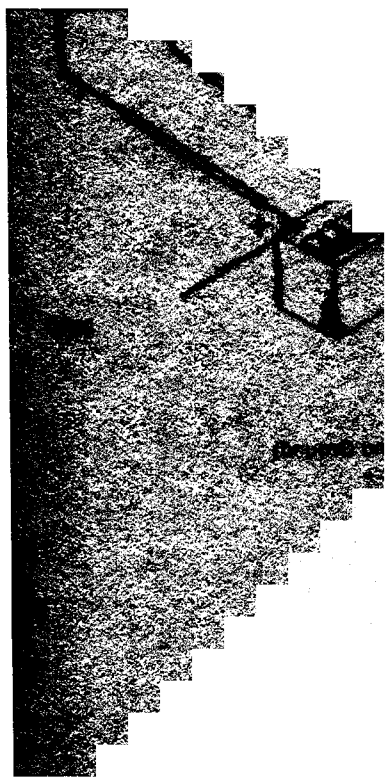
a - Output Wire - Orange
b - Excitation Wire - Purple
c - Sensing Wire - Red/Purple
d - Jumper Lead (To Tan Wire and Ground)
e - Voltmeter (0-20 Volts)

Voltage Regulator Test

⚠WARNING
Be sure that engine compartment is well-ventilated and that there are no gasoline vapors present (during the next steps) to prevent the possibility of an explosion and/or fire, should a spark occur.

⚠CAUTION
DO NOT allow jumper wire to contact alternator end frame (in next step), as diode trio and regulator may be damaged.

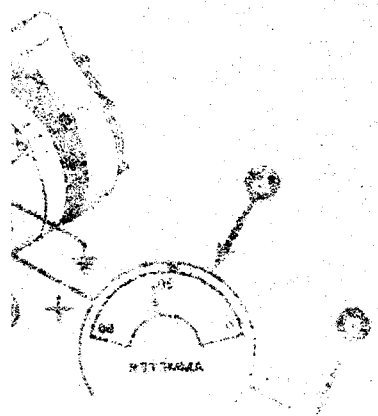
4. If reading is low, stop engine and remove 4 regulator attaching screws. Pull regulator away from alternator end frame to gain access to field terminal. DO NOT disconnect regulator terminals. Connect a jumper lead from the ground stud to the brush terminal that has a tan wire attached. Restart engine and gradually increase engine speed to 1500 RPM while observing voltmeter. DO NOT allow voltage to exceed 16 volts.
5. If a voltmeter reading of 14.5 volts or above is now obtained, voltage regulator is faulty and must be replaced. If voltmeter reading is below 14.5 volts, inspect brushes and slip rings for wear, dirt or damage. If brushes and slip rings are good, alternator is faulty internally. Disassemble alternator and test components, as outlined under "Alternator Repair," following.



Alternator Repair

Removal

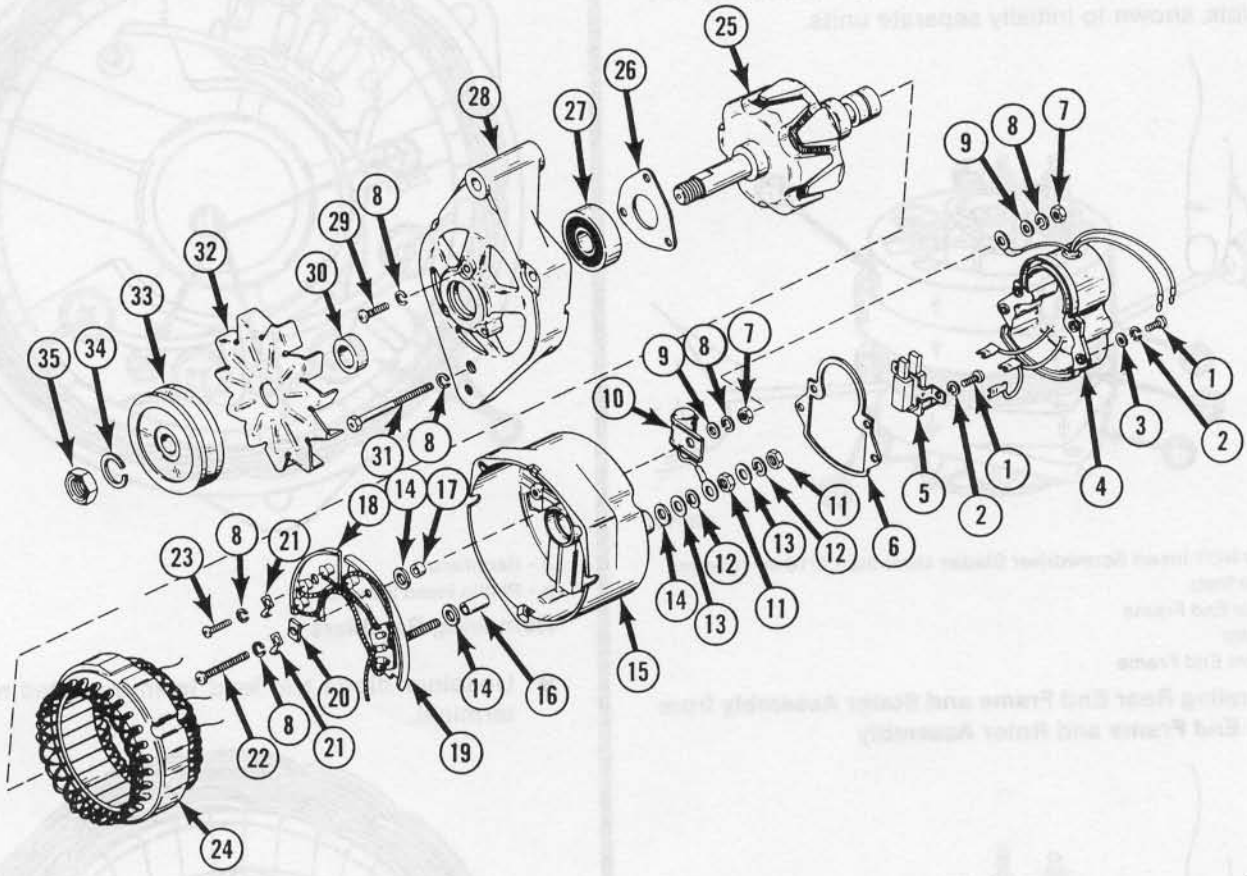
1. Disconnect negative (-) battery cable from battery.
2. Disconnect wiring harness from alternator.
3. Remove alternator brace to alternator attaching bolt, washer(s) and spacer (if used).
4. Loosen alternator brace to engine attaching bolt and alternator mounting bolt, then pivot alternator inward and remove alternator drive belt.
5. Remove alternator mounting bolt, washers (if used), spacer and nut and remove alternator.



Disassembly

IMPORTANT: The following instructions are for complete disassembly and overhaul of the alternator. In many cases, however, complete disassembly of alternator is not required and, in those cases, it is necessary only to perform the operations required to repair or replace the faulty part.

1. Mount alternator in a vise so that rear end frame is facing you.
2. Disconnect regulator leads from terminals on rear end frame. Remove 4 regulator attaching screws, then pull regulator away from rear end frame and disconnect regulator field leads. Remove regulator rubber seal.
3. Remove 2 brush set attaching screws and remove brush set.



26782

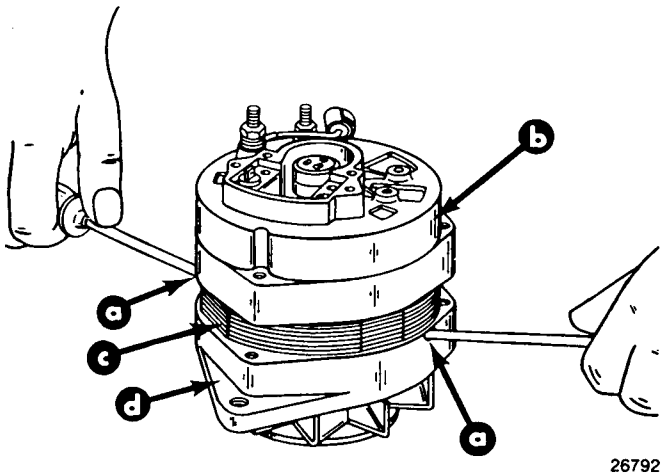
1 - Screw (6)
2 - Lockwasher (6)
3 - Flatwasher (4)
4 - Regulator
5 - Brush Set
6 - Rubber Seal
7 - Nut
8 - Lockwasher (6)
9 - Flatwasher (2)
10 - Condenser
11 - Nut
12 - Lockwasher (2)
13 - Flatwasher (2)
14 - Insulating Washer (3)
15 - End Frame
16 - Insulating Sleeve - Long
17 - Insulating Sleeve - Short
18 - Negative (-) Rectifier
19 - Positive (+) Rectifier
20 - Insulator - Rectangular
21 - Clip (2)
22 - Screw (1)
23 - Screw (2)
24 - Stator
25 - Rotor
26 - Retaining Plate
27 - Front Bearing
28 - End Frame
29 - Screw (3)
30 - Spacer
31 - Screw (3)
32 - Fan
33 - Pulley
34 - Lockwasher
35 - Nut

Mando Alternator Parts View

4. Scribe a mark on rear end frame, stator and front end frame to ensure proper reassembly later.
5. Remove 3 screws which secure end frames and stator together.

IMPORTANT: DO NOT insert screwdriver blades more than 1/16 in. (1.5mm) into openings (in next step), as stator windings may be damaged.

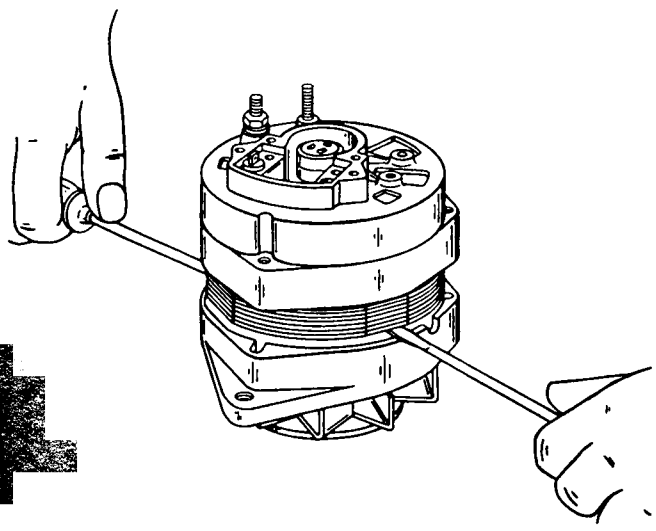
6. Separate rear end frame and stator assembly from front end frame and rotor assembly using 2 thin blade screwdrivers (positioned at 180° apart from one another) at the location shown. Use the two slots, shown to initially separate units.



26792

a - DO NOT Insert Screwdriver Blades More than 1/16 in. (1.5mm) into Slots
b - Rear End Frame
c - Stator
d - Front End Frame

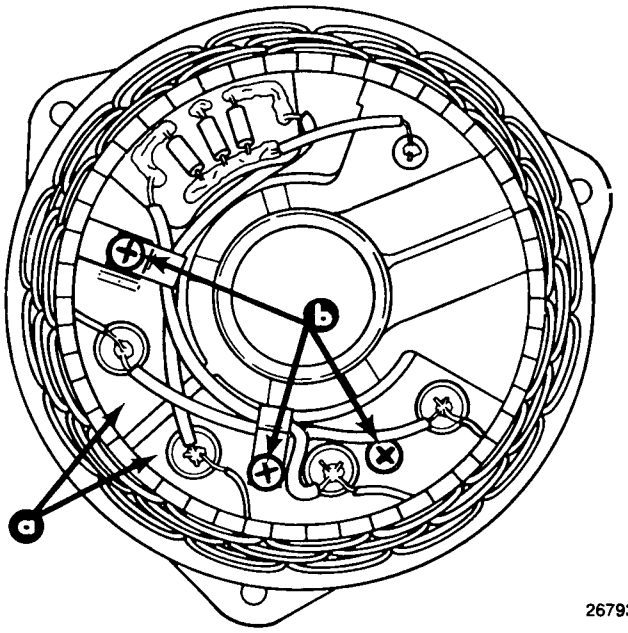
Separating Rear End Frame and Stator Assembly from Front End Frame and Rotor Assembly



26792

Separating Rear End Frame and Stator Assembly from Front End Frame and Rotor Assembly

7. Place rear end frame and stator assembly on the bench with stator downward. Be sure that bench is clean and free of metal chips. Remove nuts, washers, insulators and condenser from output and ground studs.
8. Turn end frame over (stator upward) and remove the three phillips head screws which secure rectifiers to end frame.

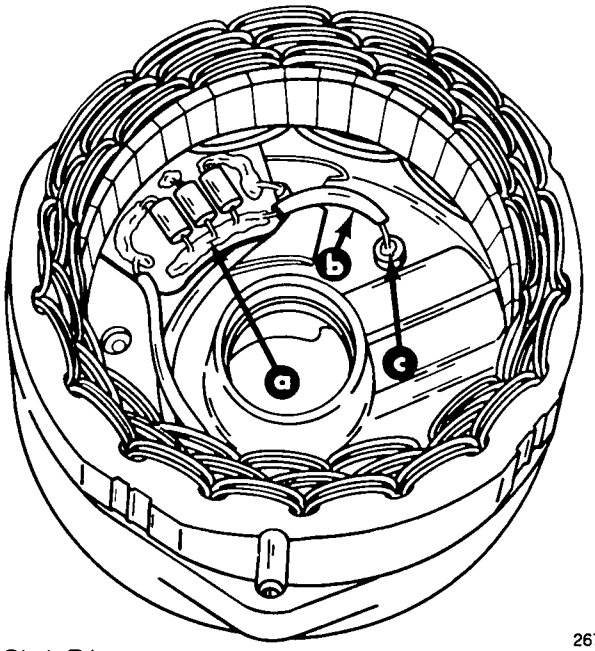


26793

a - Rectifiers
b - Phillip Head Screws

Removing Rectifiers

9. Unsolder diode trio lead from insulated regulator terminal.

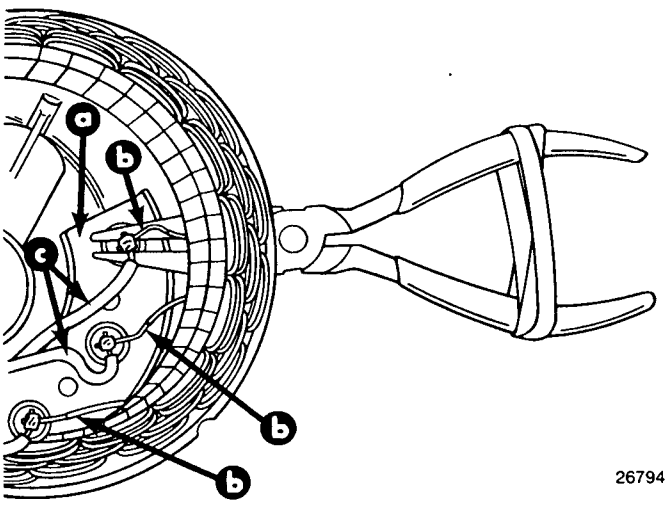


26793

a - Diode Trio
b - Diode Trio Lead
c - Insulated Terminal

Diode Trio Lead Removal

10. Unsolder the three (3) stator leads along with the three (3) coated leads from the negative (-) rectifier heat sink. Place a needle nose pliers on diode terminal between solder joint and diode body to help prevent heat damage to diodes. Unsolder joints as quickly as possible and allow diode terminal to cool before removing pliers.



26794

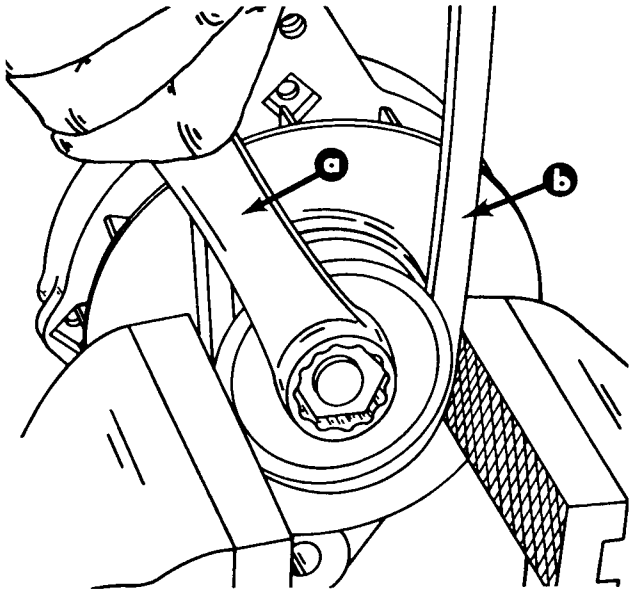
a - Negative (-) Heat Sink
b - Stator Leads (3)
c - Coated Leads (3) (2 Shown)

Unsoldering Leads from Negative (-) Rectifier Heat Sink

IMPORTANT: With alternator disassembled to this point, stator, rectifier diodes, diode trio and rotor may be tested, as explained under "Component Testing," following.

IMPORTANT: DO NOT clamp vise on rotor pole pieces when removing pulley nut (in next step), as pole pieces may be distorted.

11. Remove pulley retaining nut by clamping pulley in a vise (using an oversize V-belt or protective jaws to protect pulley) and turning nut counterclockwise with a 7/8 in. wrench. Remove lockwasher and slide pulley and fan from shaft. If pulley is "stubborn," it may be necessary to use an universal pullers.

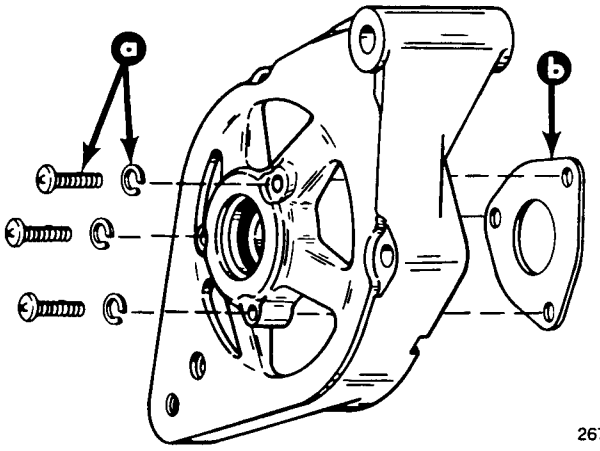


26794

a - 7/8 in. Wrench
b - Use Oversize V-Belt to Protect Pulley

Removing Pulley Nut

12. Remove the (3) phillips head screws and lockwashers which secure the front bearing retaining plate.



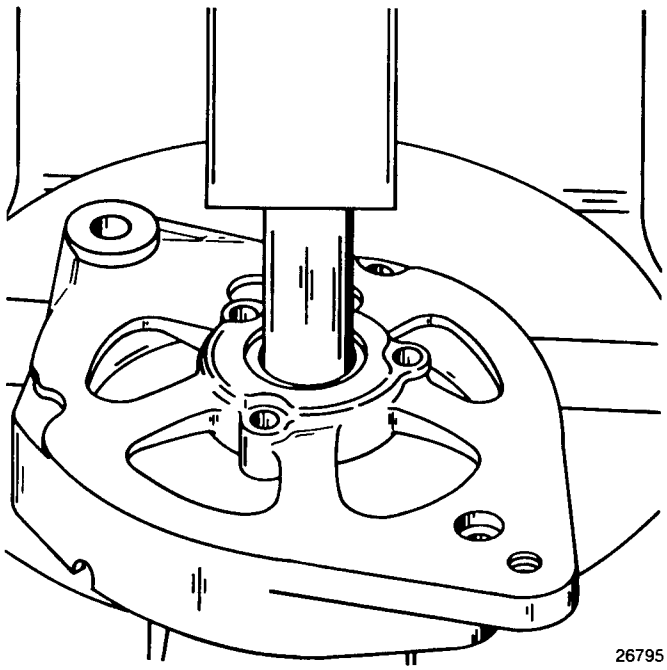
26786

a - Phillips Head Screws and Lockwashers
b - Front Bearing Retaining Plate

Removing Front Bearing Retaining Plate

13. Remove front bearing from front end frame using an arbor press and a suitable size mandrel. (Discard bearing.)

14. If rotor slip rings or rear bearing require replacement, entire rotor must be replaced. Parts cannot be purchased separately.



Removing Front Bearing from Front End Frame

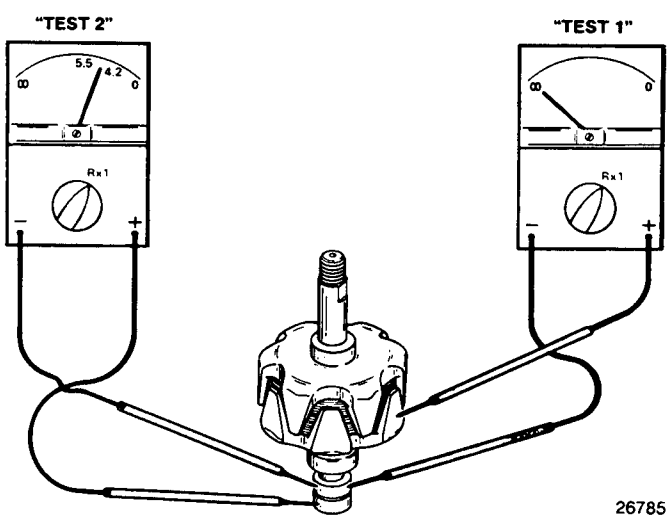
Cleaning and Inspection

1. Clean all parts with a clean, soft cloth. DO NOT use solvent, or electrical components may be damaged.
2. Inspect the following parts for wear and damage:
   a. **Brush set** - inspect for cracked porcelain casing, damaged brush leads, poor brush lead solder connections, weak or broken brush springs or worn brushes. Replace brush set if brushes are less than 1/4 in. (6mm) long.
   b. **Rotor** - inspect for stripped threads, scuffed pole piece fingers or damaged bearing surfaces (because of bearing turning on shaft).
   c. **Rotor slip rings** - clean slip rings with 400 grain (or finer) polishing cloth while spinning rotor in a lathe. Blow off dust with compressed air. Inspect slip rings for grooves, pits, flat spots or out-of-round [.002 in. (0.051mm) maximum] and replace, if present.
   d. **Rotor shaft bearings** - inspect for damaged seals, lack of lubrication, discoloration (from overheating) or excessive side or end play. Hold inner race of bearings while turning outer race. Bearing should turn freely without binding or evidence of rough spots.
   e. **Stator** - inspect for damaged insulation or wires; also inspect insulating enamel for heat discoloration, as this is usually a sign of a shorted or grounded winding or a shorted diode.
   f. **Regulator** - inspect leads for damaged insulation.
   g. **Front and rear end frames** - inspect for cracks, distortion, stripped threads or wear in bearing bore (from bearing outer race spinning in bore). End frame(s) MUST BE replaced, if bearing has spun. Also, inspect bearing retainer recess in front end frame for damage.
   h. **Fan** - inspect for cracked or bent fins, broken welds (bi-rotational fan only) or worn mounting hole (from fan spinning on shaft).
   i. **Pulley** - inspect pulley mounting bore end for wear. Inspect drive surface of pulley sheaves for trueness, excessive wear, grooves, pits, nicks or corrosion. Repair damaged surfaces, if possible, with a fine file and a wire brush or replace pulley, if beyond repair. Drive surfaces MUST BE perfectly true and smooth, or drive belt wear will be greatly accelerated.

Component Testing

ROTOR

1. Test rotor field circuit for opens, shorts or high resistance (Test 1), using an ohmmeter (set on Rx1 scale), as follows:



Testing Rotor Field Circuit

   a. Connect one ohmmeter lead to each slip ring.
   b. Ohmmeter reading should be 4.2 to 5.5 ohms with rotor at room temperature 70° - 80° F (21° - 26° C).

c. If reading is high or infinite (no meter movement), high resistance or an open exists in the field circuit. Check for poor connections between field winding leads and slip ring terminals. If cause for open or high resistance cannot be found, connect ohmmeter directly to slip ring terminals. If correct reading is now obtained, or if reading is still high or infinite, replace complete rotor assembly.

d. If reading is low, a short exists in the field circuit. Inspect slip rings to be sure that they are not bent and touching outer slip ring. Also be sure that excess solder is not shorting terminals to aft slip ring. If cause for short cannot be found, unsolder field winding leads from slip ring terminals and connect ohmmeter directly to leads. If correct reading is now obtained, or if reading is still low, slip rings and rotor field windings are shorted, and complete rotor assembly must be replaced.

2. Test rotor field circuit for grounds (Test 2), using an ohmmeter (set on Rx1 scale) as follows:

   a. Connect one lead of ohmmeter to either slip ring and the other lead to rotor shaft or pole pieces.

   b. Meter should indicate no continuity (meter should not move).

   c. If continuity does exist, rotor field circuit is grounded. Inspect slip ring terminals to be sure that they are not bent and touching rotor shaft. Also be sure that excess solder is not grounding terminals to rotor shaft. If cause for ground cannot be found, unsolder field winding leads from slip ring terminals and connect ohmmeter between one of the leads and rotor shaft or pole pieces. If continuity still exists, replace motor assembly. If continuity is eliminated, replace slip rings.

IMPORTANT: If alternator has output at low speeds, but no output at high speeds, rotor field winding may be shorting or grounding out, because of centrifugal force. Replace rotor, if all other electrical components test good.

STATOR

IMPORTANT: Stator leads MUST BE disconnected from rectifier diodes and diode trio for this test.

1. Test stator for grounds (Test 1), using an ohmmeter (set on Rx1 scale) as follows:

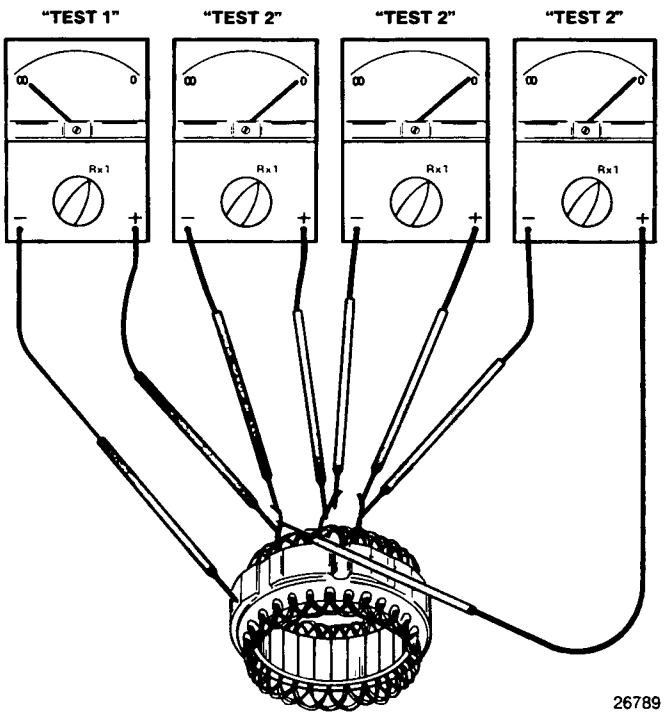
   a. Connect one lead of ohmmeter to one of the stator leads and the other lead to stator frame. Be sure that lead makes good contact with frame.

   b. Meter should indicate no continuity (meter should not move). If continuity does exist, stator is grounded and must be replaced.

2. Test for opens in stator (Test 2), using an ohmmeter (set on Rx1 scale) as follows:

   a. Connect ohmmeter between each pair of stator windings (3 different ways).

   b. Continuity should be present in all 3 cases (meter should move). If it does not, one or more of the windings are open and stator must be replaced.



Testing Stator

3. A short in the stator is difficult to detect without special equipment, because of the low windings resistance. If all other electrical components test out good, and alternator fails to produce rated output, stator probably is shorted and should be replaced. Also, examine stator for heat discoloration, as this usually is a sure sign of a short.

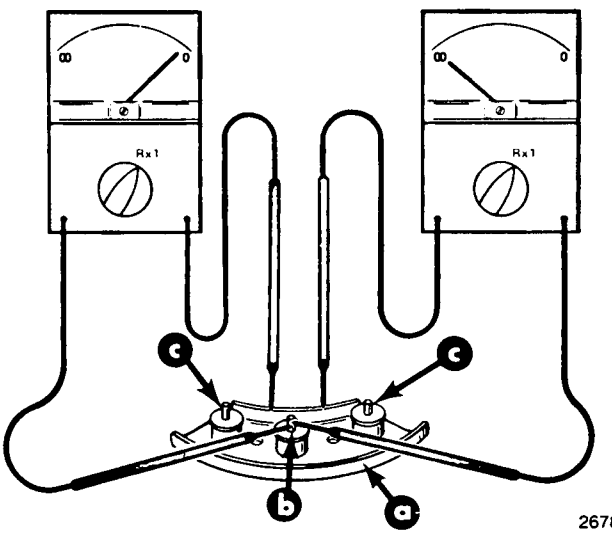
NEGATIVE (-) RECTIFIER DIODES

IMPORTANT: Rectifier diodes MUST BE disconnected from stator for this test.

⚠CAUTION

DO NOT use a test instrument with more than a 12-volt source (in the following test), as rectifier diodes may be damaged.

1. Connect one lead of an ohmmeter (set on Rx1 scale) to negative (-) rectifier diode heat sink and the other lead to one of the rectifier diode terminals. Note the reading.
2. Reverse leads and again note reading.
3. Meter should indicate a high or infinite resistance (no meter movement) when connected one way and a low reading when connected the other. If both readings are high or infinite, diode is open. If both readings are low, diode is shorted.
4. Repeat Steps 1-thru-3 for 2 other rectifier diodes in heat sink.
5. Replace complete rectifier set, if any of the diodes is shorted or open.



26784

a - Heat Sink
b - Diode Terminal
c - Test These 2 Diodes in Same Manner

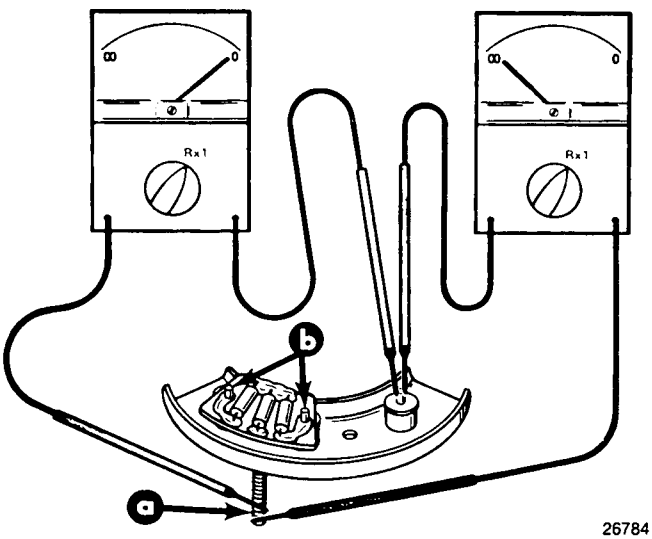
Testing Negative (-) Rectifier Diodes for Shorts or Opens

⚠CAUTION

DO NOT use a test instrument with more than a 12-volt source (in the following test), as rectifier diodes may be damaged.

POSITIVE (+) RECTIFIER DIODES and DIODE TRIO

1. Connect one lead of an ohmmeter (set on Rx1 scale) to 1/4 in. stud on positive (+) rectifier heat sink and the other lead to one of the rectifier diode terminals. (Note: Two of the diode terminals come up thru the diode trio circuit board.) Note the meter reading.
2. Reverse leads and again note reading.
3. Meter should indicate a high or infinite resistance (no meter movement) when connected one way and a low reading when connected the other. If both readings are high or infinite, diode is open. If both readings are low, diode is shorted.
4. Repeat Steps 1-thru-3 for 2 other rectifier diodes in heat sink.

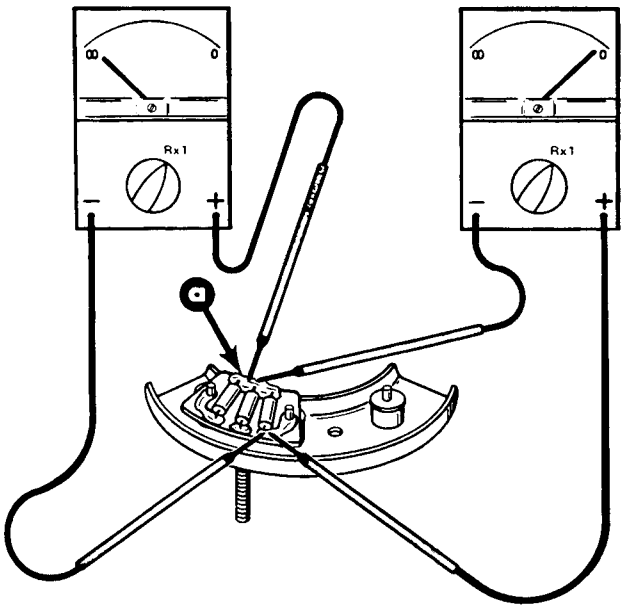


26784

a - Stud
b - Repeat Test between These Terminals and Stud

Testing Positive (+) Rectifier Diodes for Shorts or Opens

5. Replace complete rectifier set, if any one of the diodes is shorted or open.
6. Connect one lead of an ohmmeter (set on Rx1 scale) to the common side on the diode trio circuit board and the other lead to the other side of one of the three (3) trio diodes.



26783

a - Common Side of Diode Trio Circuit Board

Testing Diode Trio for Shorts or Opens

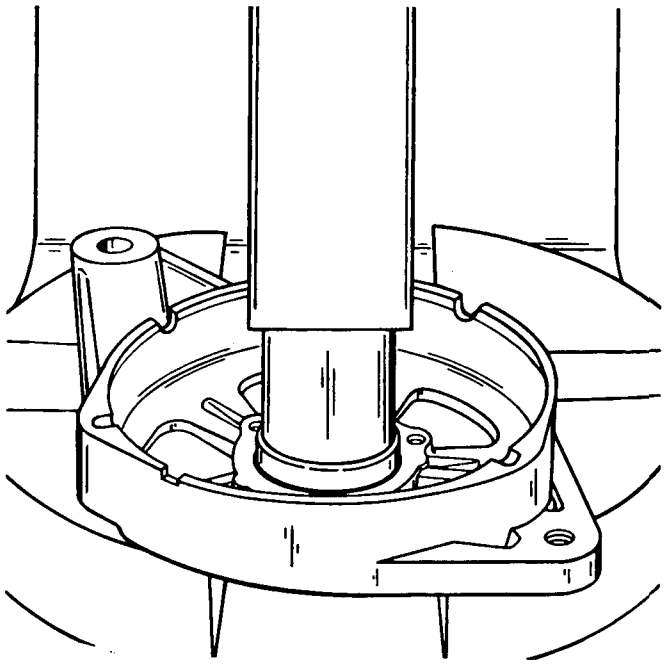
7. Reverse leads and again note reading.
8. Meter should indicate a high or infinite resistance (no meter movement) when connected one way and a low reading when connected the other. If both readings are high or infinite, diode trio is open. If both readings are low, diode trio is shorted.
9. Repeat Steps 6-thru-8 for the other 2 diodes.
10. Replace positive (+) rectifier and diode trio assembly if any one of the diodes is shorted or open.

CONDENSER

1. Using Magneto Analyzer and accompanying instructions, perform the following condenser tests:
   a. Condenser Capacity Test (must be .5 mfd).
   b. Condenser Short or Leakage Test.
   c. Condenser Series Resistance Test.
2. Replace condenser, if test results are not within specifications.

Reassembly

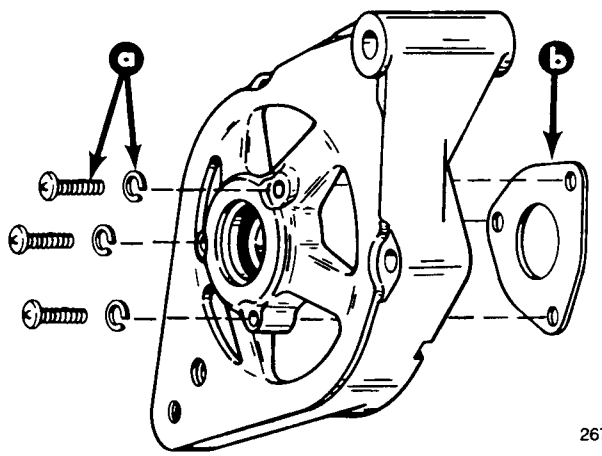
1. Install new front bearing into front end frame bearing bore using an arbor press. If necessary, use a bearing driver that contacts outer race only.



26795

Installing Front Bearing into Front End Frame

2. Install front bearing retaining plate using 3 phillips head screws and lockwashers.



26786

a - Phillips Head Screws and Lockwashers
b - Front Bearing Retaining Plate

Installing Front Bearing Retaining Plate

3. Slide front end frame over rotor.

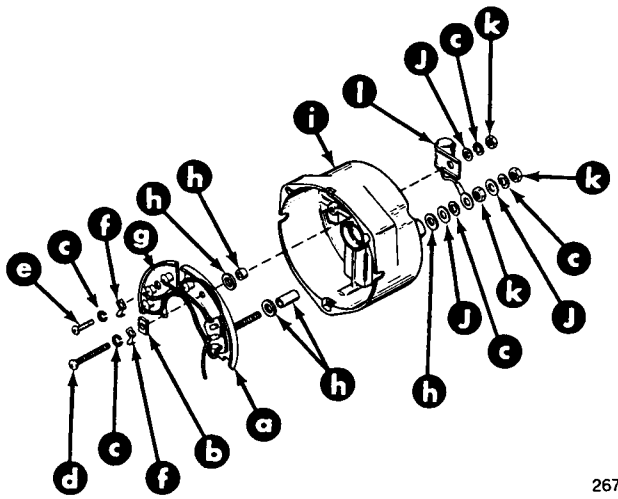
IMPORTANT: DO NOT clamp vise on rotor pole pieces when tightening pulley nut (in next step), or pole pieces may be distorted.

4. Slide fan spacer onto rotor shaft. Install fan, pulley, lockwasher and nut on shaft. Clamp pulley in a vise, using protective jaws or an old oversize V-belt to protect pulley, and torque nut to specifications. Tighten vise only enough to allow tightening of nut, as excessive tightening may distort pulley.

IMPORTANT: The insulating washers MUST BE installed as shown or damage to the alternator WILL result.

5. Install positive (+) and negative (-) rectifier heat sinks, shown.

6. Position rear end frame and stator assembly over front end frame and rotor assembly and align scribe marks on each (scribed during assembly). Hand-press end frames together, then install screws. Tighten screws securely.



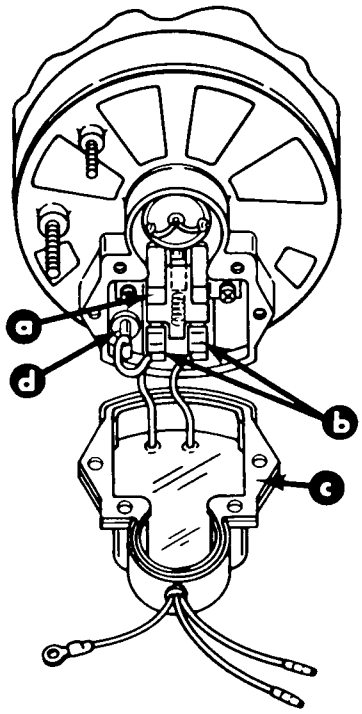
26790

a - Positive (+) Rectifier Heat Sink
b - Rectangular Insulator
c - Lockwasher
d - Screw - 1-1/2 in. (38mm) Long
e - Screw - 1/2 in. (13mm) Long; 2 Required
f - Clip
g - Negative (-) Rectifier Heat Sink
h - Insulator
i - Rear End Frame
j - Flat Washer
k - Nut
l - Condenser

Installing Positive (+) and Negative (-) Rectifier Heat Sinks

7. Place brush set in rear end frame cavity and secure with 2 mounting screws, as shown. Be sure to use outermost mounting holes. Tighten screws securely.

8. Position rubber seal on regulator mounting surface. Connect regulator field leads and regulator lead to brush and regulator terminals (shown), then mount regulator with 4 screws. Connect ground terminal and secure with lockwashers and nuts. Tighten screws and nuts securely.



26789

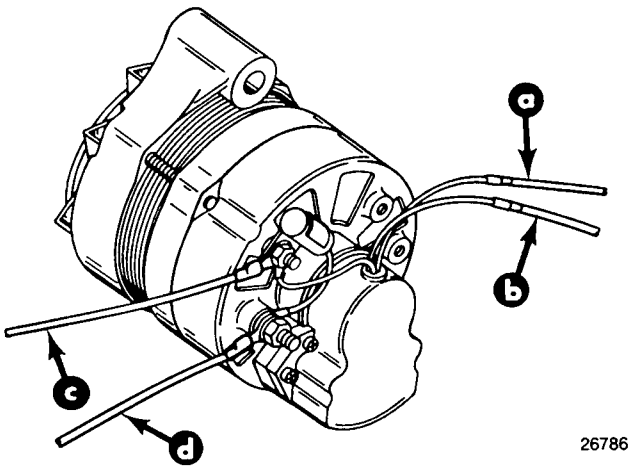
a - Brush Set (Use Outer Mounting Holes)
b - Be Sure to Connect Field Leads as Shown
c - Regulator Rubber Seal
d - Insulated Regulator Terminal

Installing Brush Set and Regulator

IMPORTANT: Regulator field leads MUST BE connected as shown, or leads may be damaged by rotor slip rings during operation.

Installation

1. Position alternator in mounting bracket and install mounting bolt, washers (if used), spacer and nut. Place washers (if used), on each side of spacer. DO NOT tighten securely at this time.
2. Fasten alternator brace to alternator with bolt, washers and spacer (if used). DO NOT tighten bolt at this time.
3. Position alternator drive belt on pulleys and adjust tension as explained under "Drive Belt Tension Adjustment."
4. Reconnect wiring harness to alternator and negative battery cable to battery.



a - Excitation Lead (Purple)
b - Sensing Lead (Red/Purple)
c - Ground Lead (Black)
d - Output Lead (Orange)

Wiring Harness Connected to Alternator

Prestolite (Motorola) Alternator

Specifications

Voltage Output	13.8 - 14.8 Volts
Current Output	51 Amps
Excitation Circuit	1.5 - 3.0 Volts
Condenser Capacity	.5 mfd
Minimum Brush Length	3/16 in. (5mm)

Special Tools

Multi-Meter/DVA Tester	91-99750
Magneto Analyzer	91-76032

TOOLS PURCHASED LOCALLY

Ammeter (0-50 Amps)

Torque Specifications

Housing Screws	50-60 lb. in. (6 N·m)
Pulley Nut	35-50 lb. ft. (48-68 N·m)
Front Bearing Screws	25-35 lb. in. (3 N·m)
Alternator Mount	35 lb. ft. (48 N·m)
Adjustment Bolt	16 lb. ft. (28 N·m)
Tighten All Other Fasteners Securely	

Sealants

Liquid Neoprene	92-25711
Heat Sink Compound — Obtain Locally	

Description

The alternator employs a rotor, which is supported in 2 end frames by ball bearings, and is driven (via a pulley) at approximately twice engine speed. The rotor contains a field winding that is enclosed between 2 multiple-finger pole pieces. The ends of the field windings are connected to 2 brushes (mounted in the rear end frame) which make continuous sliding (or slipping) contact with the slip rings. The current (flowing through the field winding) creates a magnetic field that causes the adjacent fingers of the pole pieces to become alternate north and south magnetic poles.

A 3-phase stator is mounted directly over the rotor pole pieces and between the 2 end frames. It consists of 3 windings wound 120° electrically out-of-phase on the inside of a laminated core. The windings are all connected together on one end, while the other ends are connected to a full-wave rectifier bridge.

The rectifier bridge contains 6 diodes which are arranged so that current flows from ground, thru the stator and to the output terminal, but not in the opposite direction.

When current is supplied to the rotor field winding, and the rotor is turned, the movement of the magnetic fields created induces an alternating current into the stator windings. The rectifier bridge then changes this alternating current to direct current which appears at the output terminal. A diode trio also is connected to the stator windings to supply current to the regulator and the rotor field during operation.

Voltage output of the alternator is controlled by regulating the current supplied to the rotor field. This is accomplished by a transistorized voltage regulator that senses the voltage at the battery and regulates the field current to maintain alternator voltage within prescribed limits for properly charging the battery. Current output of the alternator does not require regulation, as maximum current output is self-limited by the design of the alternator. As long as the voltage is regulated within the prescribed limits, the alternator cannot produce excessive current. A cutout relay in the voltage regulator also is not required, as the rectifier diodes (which allow current to flow in one direction only) prevent the battery from discharging back through the stator.

Due to the lack of residual magnetism in the rotor pole pieces, a small amount of current must be supplied to the rotor field to initially start the alternator charging. This is accomplished by means of an excitation circuit in the regulator which is connected to the ignition switch. Once the alternator begins to produce output, field current is supplied solely by the diode trio, as explained, preceding.

The alternator also is equipped with a fan (mounted on the rotor shaft) which induces air flow through the alternator to remove the heat created by the rectifier and stator. A capacitor also is utilized to protect the rectifier system from high voltages and to suppress radio noise.

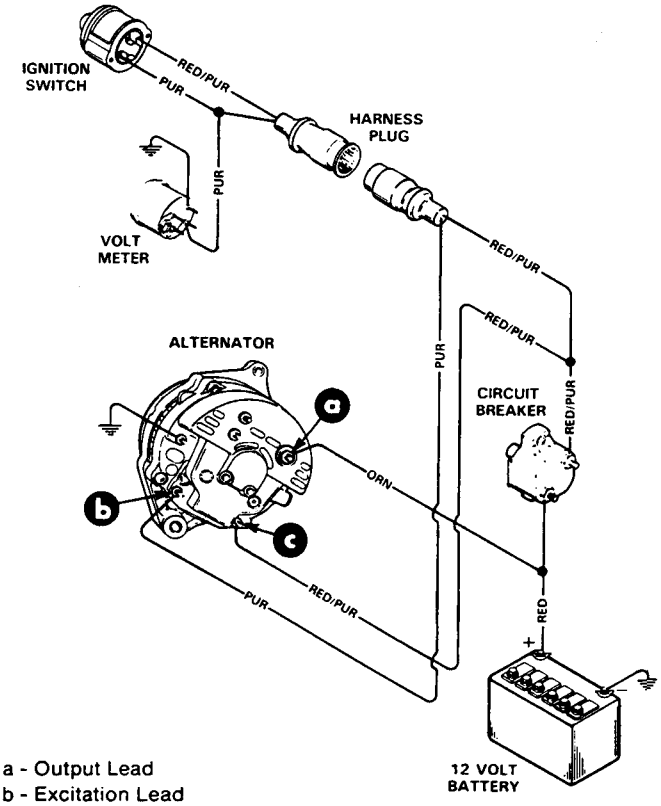
Diagnosis on Engine

Before proceeding with the tests, perform the following checks to eliminate possible problem areas. Also observe "Precautions," immediately preceding, to prevent damage to alternator system.

1. If problem is an undercharged battery, check to ensure that undercharged condition has not been caused by excessive accessory current draw or by accessories which have accidentally been left on. Also, check that undercharged condition has not been caused by running engine at too low a speed for extended periods of time.
2. Check physical condition and state of charge of battery. Battery must be at least 75% (1.230 specific gravity) of fully charged to obtain valid results in the following tests. If not, charge battery before testing system.
3. Inspect entire alternator system wiring for defects. Check all connections for tightness and cleanliness, particularly battery cable clamps and battery terminals.
4. Check alternator drive belt and replace if necessary. Also, check tension and adjust if necessary, as outlined under "Drive Belt Replacement and Adjustment."

System Components

The alternator system, used on engines with Prestolite Alternators, consists of the alternator, battery, the ignition switch and the wiring which connects these components.



a - Output Lead
b - Excitation Lead
c - Sensing Lead

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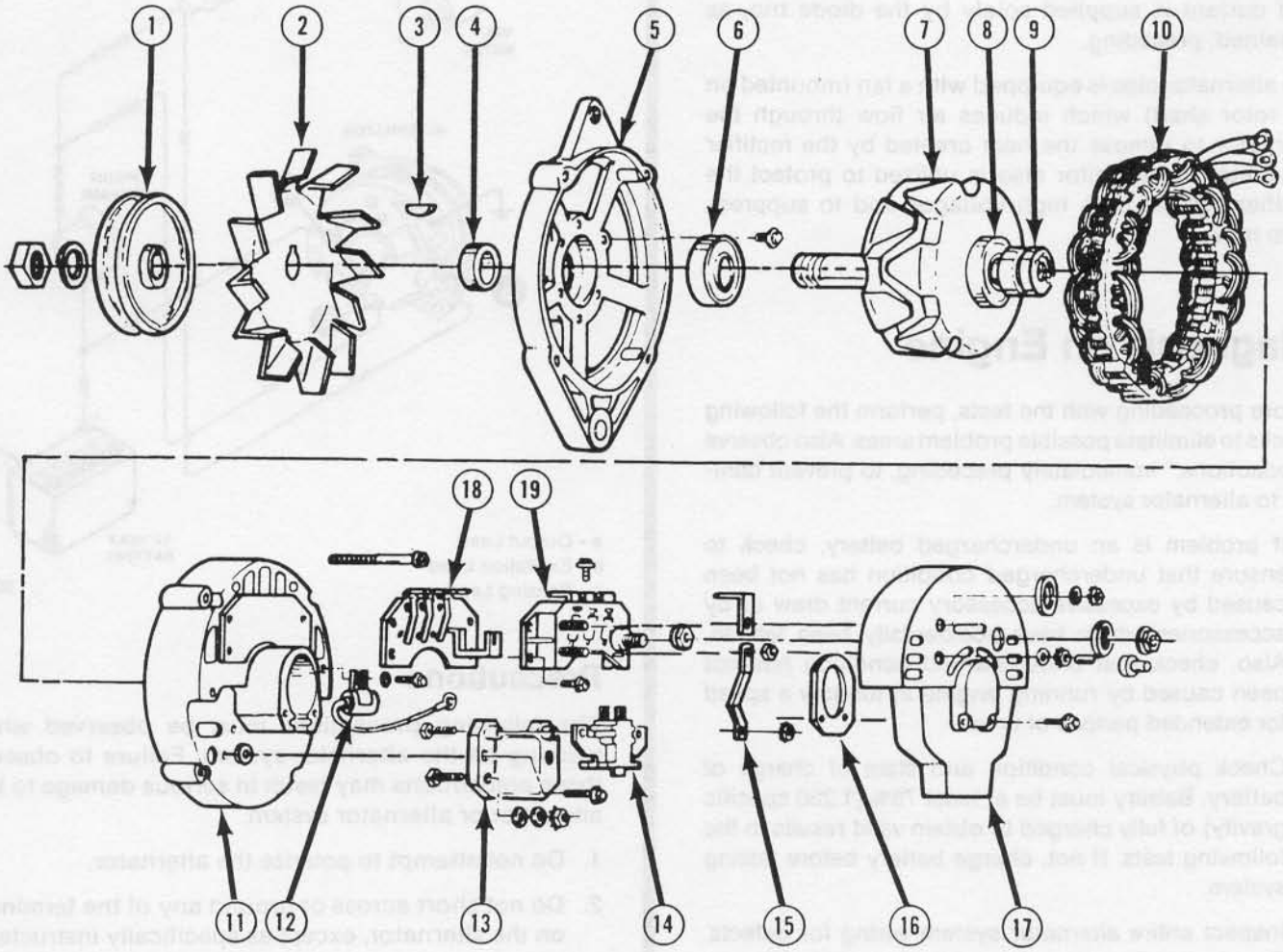
Precautions

The following precautions must be observed when working on the alternator system. Failure to observe these precautions may result in serious damage to the alternator or alternator system.

1. Do not attempt to polarize the alternator.
2. Do not short across or ground any of the terminals on the alternator, except as specifically instructed.
3. Never disconnect the alternator output lead or battery cables when the alternator is being driven by the engine.
4. Never disconnect regulator lead from alternator regulator terminal when the alternator is being driven by the engine.
5. Always remove negative (-) battery cable from battery before working on alternator system.
6. When installing battery, be sure to connect the negative (-) (grounded) battery cable to negative (-) battery terminal and the positive (+) battery cable to positive (+) battery terminal.
7. If a charger or booster battery is to be used. Be sure to connect it in parallel with existing battery (positive to positive; negative to negative).

Prestolite Alternator (Exploded View)



1 - Pulley
2 - Fan
3 - Woodruff Key
4 - Fan Spacer
5 - Front Housing
6 - Front Bearing
7 - Rotor
8 - Rear Bearing
9 - Slip Rings
10 - Stator
11 - Rear Housing
12 - Capacitor
13 - Voltage Regulator
14 - Brush Assembly
15 - Strap
16 - Felt Gasket
17 - Cover
18 - Rectifier Bridge
19 - Diode Trio

Alternator/Regulator Tests

Perform the following tests, using a 0-20 volt DC voltmeter, to check that all of the circuits between the alternator and the other components within the alternator system are in good condition.

⚠WARNING
Be sure that engine compartment is well-ventilated and that there are no gasoline vapors present (during the test) to prevent the possibility of an explosion and/or a fire, should a spark occur.

Test No. 1 (Alternator Output Test)

Connect voltmeter to alternator output terminal (orange wire). With engine running about 1500 RPM and accessories (running light, radio, depth finder, etc.) turned on, voltage should be between 13.8 - 14.8. (Voltage may vary a few tenths of a volt [higher or lower] due to ambient temperature variations.)

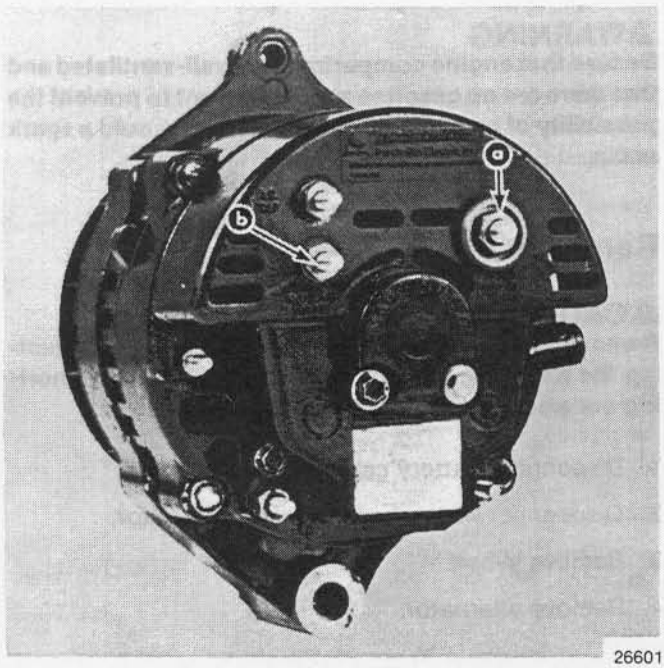
If voltage output does not fall within specifications, alternator should be disassembled for further inspection and tests.

Test No. 2 (Harness Voltage Test)

With ignition off, unplug red/purple wire and check for battery voltage at harness wire. No voltage indicates wiring harness is "open" and should be repaired or replaced.

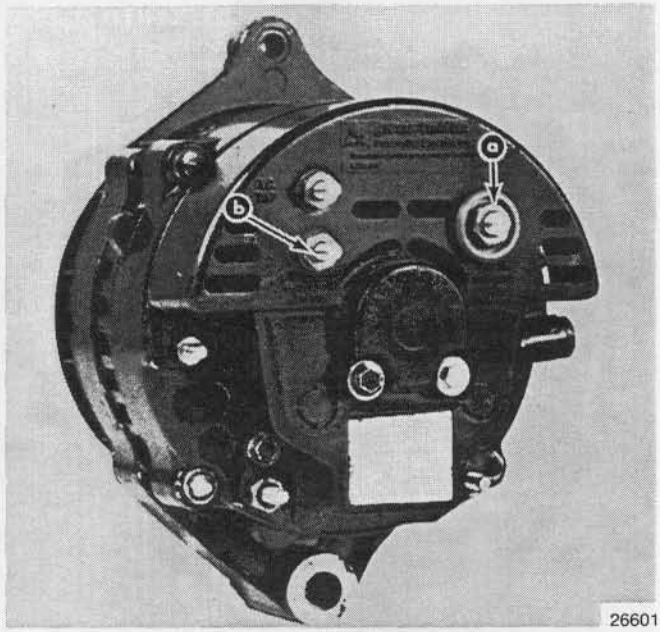
Test No. 3 (Open Diode-Trio Test)

1. With ignition on and engine not running, check for battery voltage at terminal (a) and 1.5 to 3.0 volts at terminal (b).



26601

2. Connect a jumper wire between terminal (a) and (b). Start engine and run at idle. If charging voltage (13.8 - 14.8 volts) is present at terminal (a), the diode-trio is probably defective and alternator should be removed for repair.



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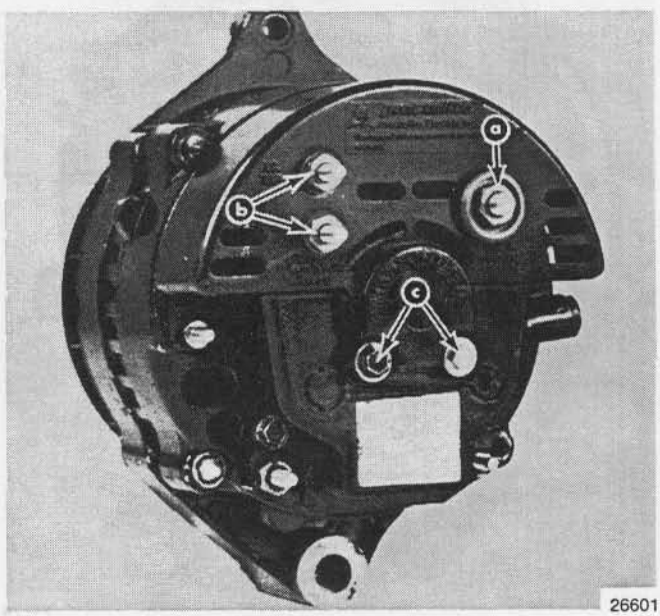
Test No. 4 (Open Regulator Test)

IMPORTANT: This test requires removal of back cover of alternator.

⚠CAUTION
To prevent electrical system damage and/or sparks, disconnect battery cables at battery before removing wiring from alternator.

1. Disconnect battery cables at battery.
2. Disconnect output wire and remove terminal nut (a). Remove nuts (b) and screws (c). Remove cover.



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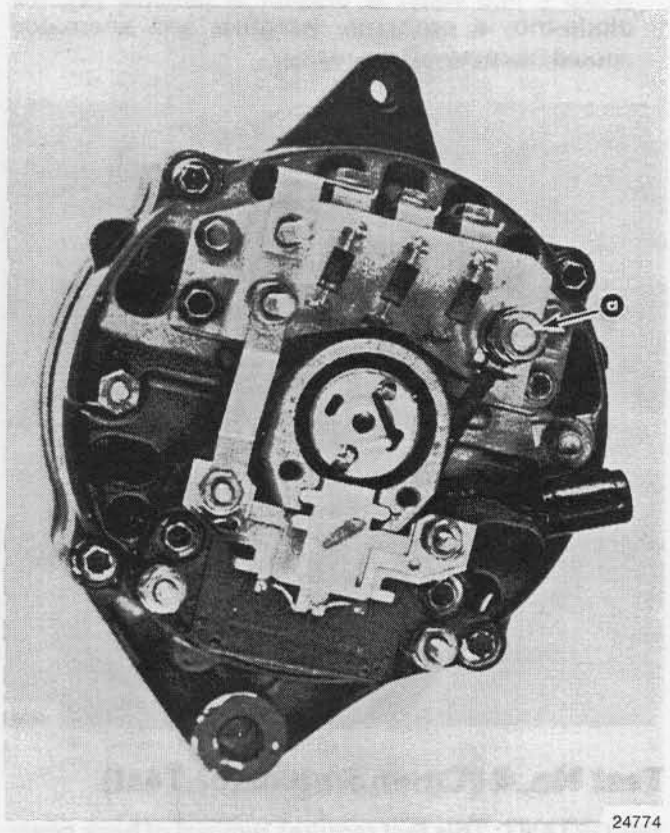
3. Reconnect output wire on terminal (a). Reconnect battery cables.



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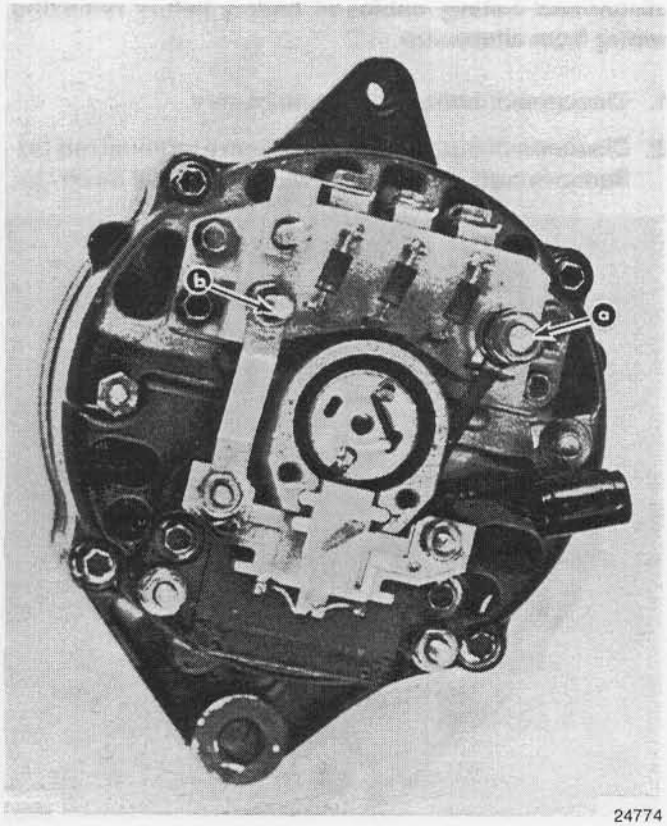
4. With ignition switch on and engine not running, check for battery voltage at terminal (a) and terminal (b).



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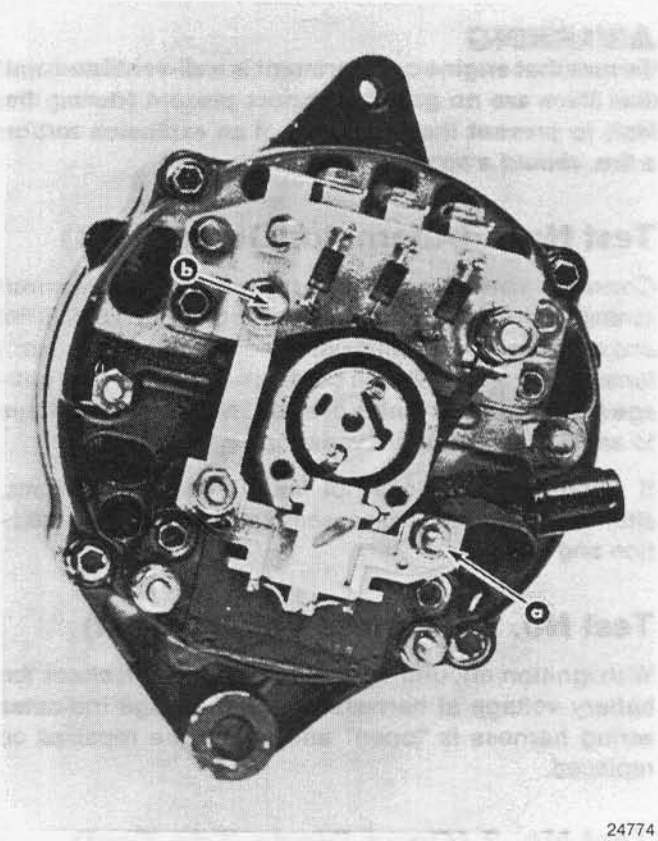
5. Connect a jumper wire between field terminal (a) and ground. If 1.5 to 3.0 volts are present at terminal (b), regulator is defective. If voltage is not present at terminal (b), there is an open field circuit (brushes, slip rings, etc.). Remove alternator for repair.



24774

Repair

⚠WARNING
Be sure that engine compartment is well-ventilated and that there are no gasoline vapors present to prevent the possibility of an explosion and/or a fire, should a spark occur.

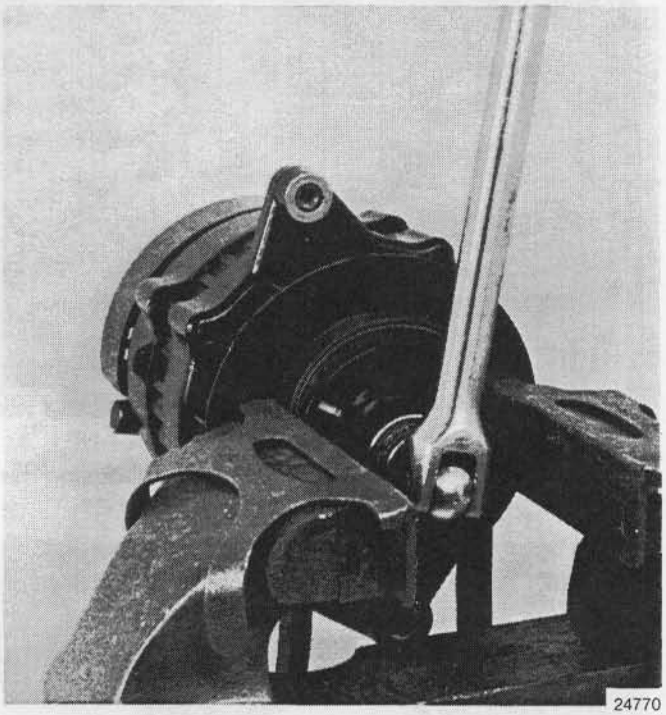
Removal

⚠CAUTION
Remove all battery cables from battery (before conducting the following check) to prevent accidentally shorting out electrical system.

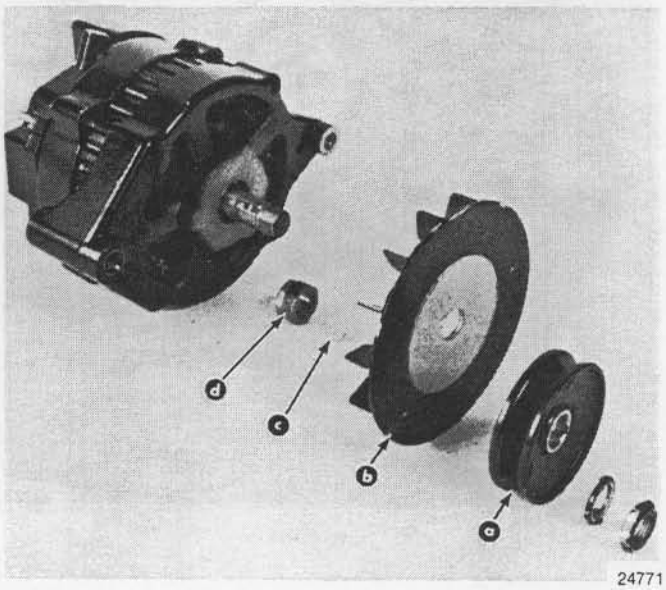
1. Disconnect battery cables from battery.
2. Disconnect wiring harness from alternator.
3. Remove V-belt.
4. Remove alternator.

Disassembly

1. Using an oversized V-belt to protect the pulley, clamp alternator in vise, as shown. Remove pulley nut.


24770

2. Remove pulley (a), fan (b), woodruff key (c) and spacer (d).



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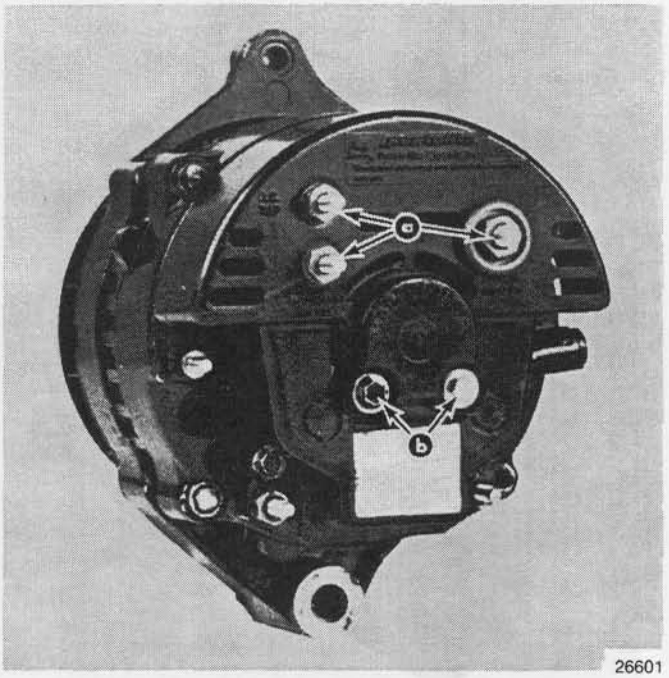
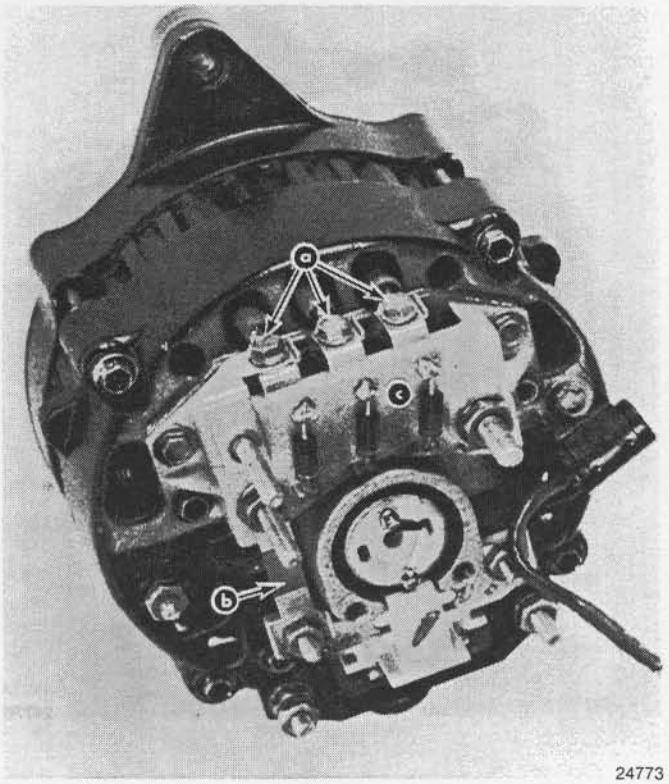
3. Remove nuts (a) and screws (b) to remove rear cover.



26601

4. Disconnect stator wires (a). Remove strap (b). Remove diode-trio and rectifier bridge (c).



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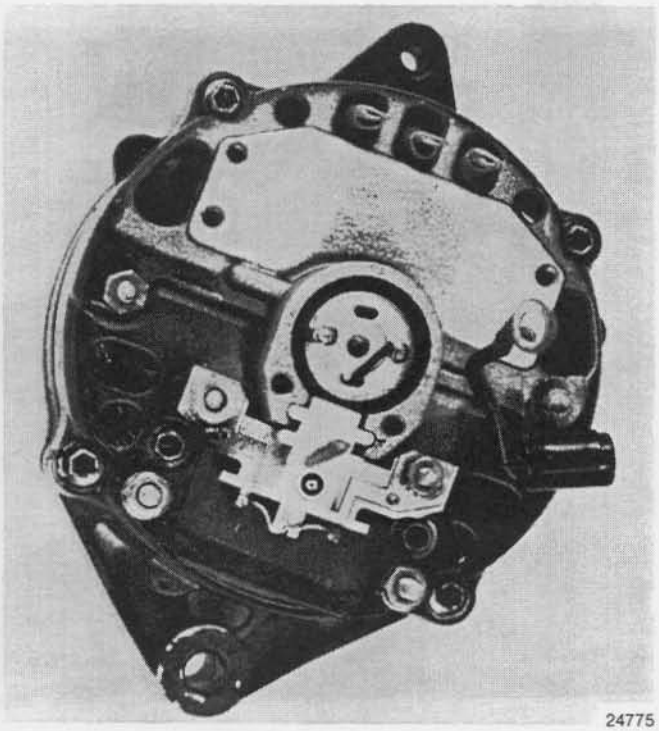
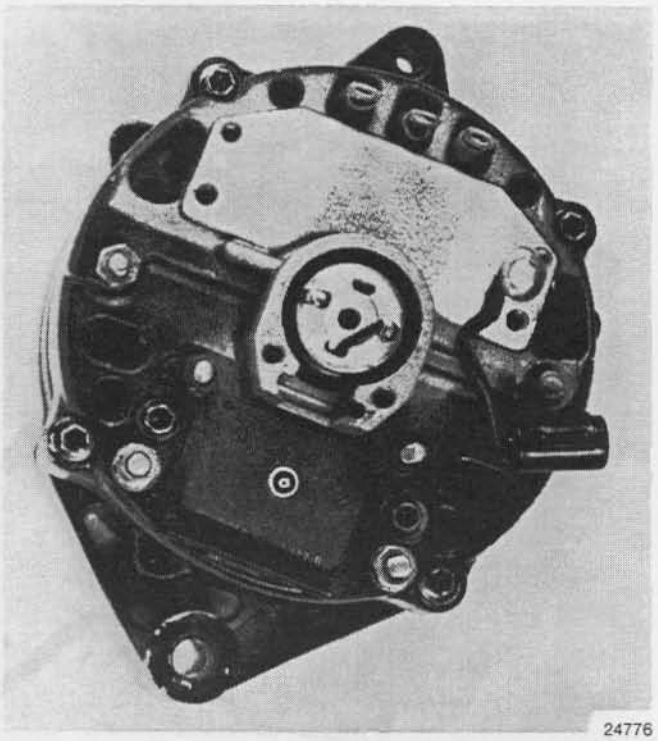
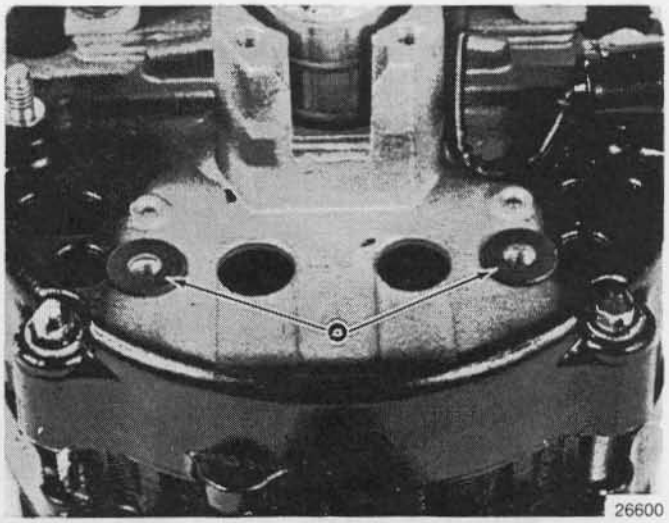
5. Remove brush holder (a).



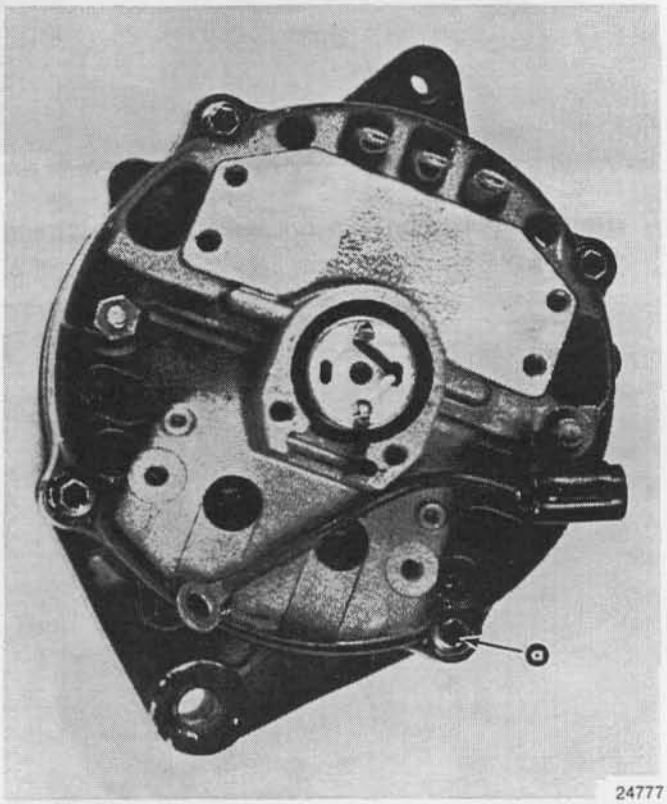
6. Remove regulator (a).



IMPORTANT: Do not lose fiber washers (a).



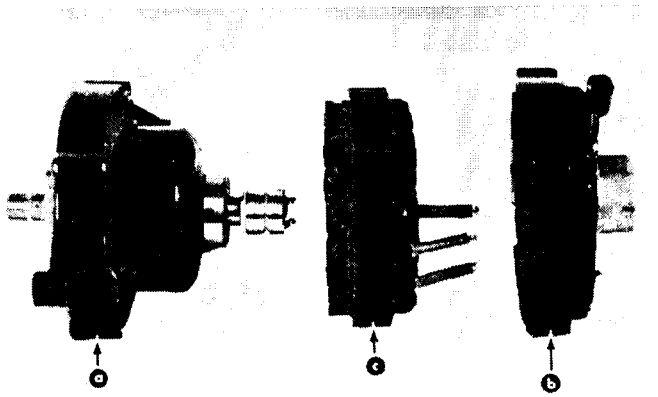
7. Mark front housing, stator, and rear housing for reassembly. Remove four (4) screws (a).



8. Carefully insert two screwdriver blades in opposite openings between stator and front housing.

⚠CAUTION
Do not insert screwdriver blades deeper than 1/16 in. (1.5mm) to avoid damaging stator windings.

Pry front and rear housings, (a) and (b), from stator (c).



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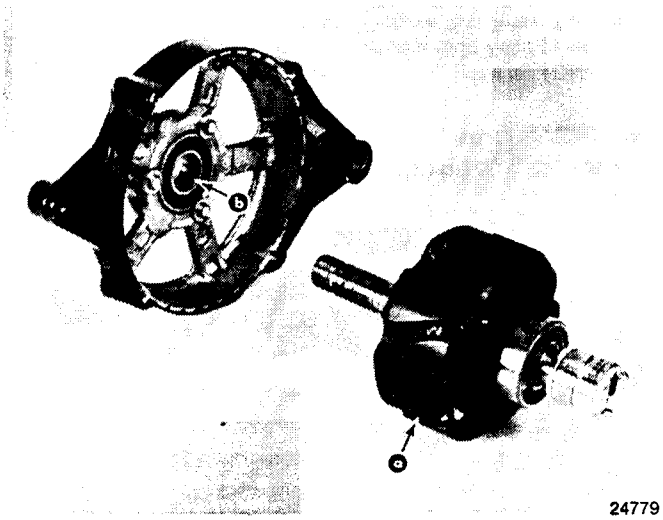
9. While supporting front housing, use an arbor press to remove rotor (a) from front bearing (b).



24779

Inspection and Cleaning

1. Clean all parts with a clean, soft cloth. Do not use solvent, or electrical components may be damaged.
2. Inspect the following:
   a. **Brush set** — inspect for cracked porcelain casing, damaged brush leads, poor brush springs or worn brushes. Replace brush set if brushes are less than 3/16 in. (5mm) long.
   b. **Rotor** — inspect for stripped threads, scuffed pole piece fingers or damaged bearing surfaces (because of bearing turning on shaft).
   c. **Rotor slip rings** — clean slip rings with 400 grain (or finer) polishing cloth. Blow off dust with compressed air. Inspect slip rings for grooves, pits, flat spots, or out-of-round (.002 in. [0.05mm] maximum); replace, if defective.
   d. **Rotor shaft bearings** — inspect for damaged seals, lack of lubrication, discoloration (from overheating) or excessive side or end play. Hold inner race of bearings while turning outer race. Bearing should turn freely without binding or evidence of rough spots.
   e. **Stator** — inspect for damaged insulation or wires; also inspect insulating enamel for heat discoloration, as this is usually a sign of a shorted or grounded winding or a shorted diode.
   f. **Regulator** — inspect leads for damaged insulation.
   g. **Front and rear housings** — inspect for cracks, distortion, stripped threads or wear in bearing bore (from bearing outer race spinning in bore); replace if defective.
   h. **Fan** — inspect for cracked or bent fins, broken welds or worn mounting hole (from fan spinning on shaft).
   i. **Pulley** — inspect pulley mounting bore end for wear. Inspect drive surface of pulley sheaves for trueness, excessive wear, or corrosion. Repair damaged surfaces, if possible, with a fine file and a wire brush or replace pulley. Drive surfaces must be perfectly true and smooth, or drive belt wear will be greatly accelerated.
   j. **Alternator** — if alternator has output at low speeds, but no output at high speeds, rotor field winding may be shorting or grounding out, because of centrifugal force. Replace rotor, if all other electrical components test good.

Front Bearing

Removal

1. Remove retaining screws.
2. Use an arbor press to remove bearing from housing.

Installation

1. Using an arbor press, press on outer race of new bearing until fully seated in housing.
2. Install retaining screws. Tighten to 25-35 lb. in. (3 N·m).

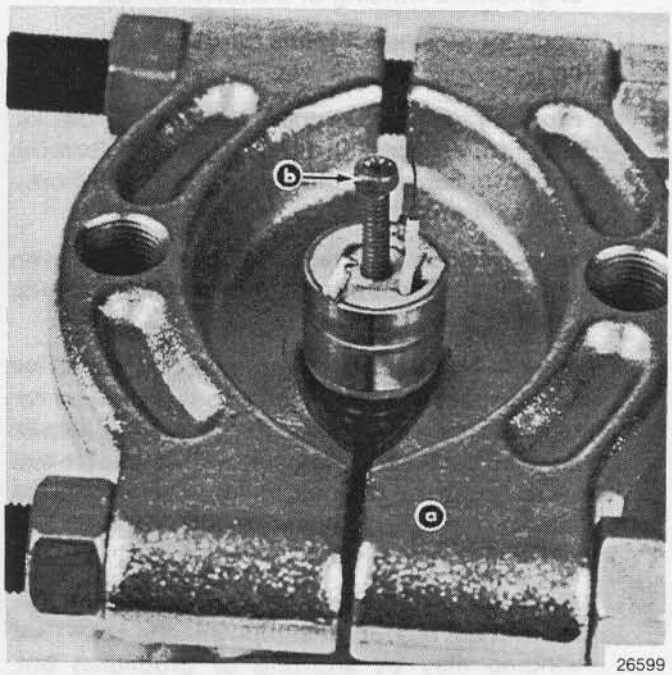
Slip Rings/Rear Bearing

Removal

1. Unsolder wires and carefully unwind them from slip ring terminals.

IMPORTANT: Do not damage rotor wires when removing slip rings or bearing.

2. Install a universal puller plate (a) between bearing and slip rings. Insert a 10 x 1 in. cap screw (b) into opening of slip ring assembly.

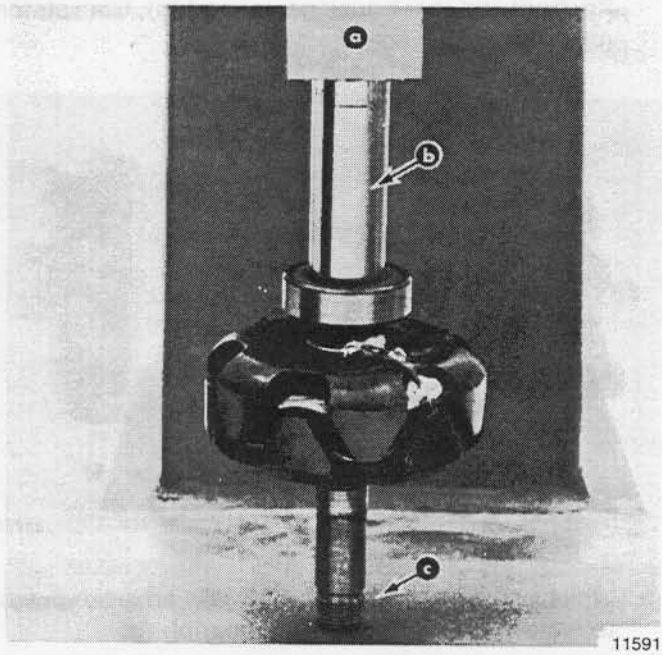


26599

3. Using an arbor press, push against cap screw to remove slip rings.
4. Install a universal puller plate under bearing.
5. Using an arbor press, remove bearing.

Installation

1. Press new rear bearing all-the-way onto rotor shaft (until inner race contacts shoulder) with an arbor press and a bearing driver that contacts inner bearing race only, as shown. Use extreme care to prevent damage to field winding leads.

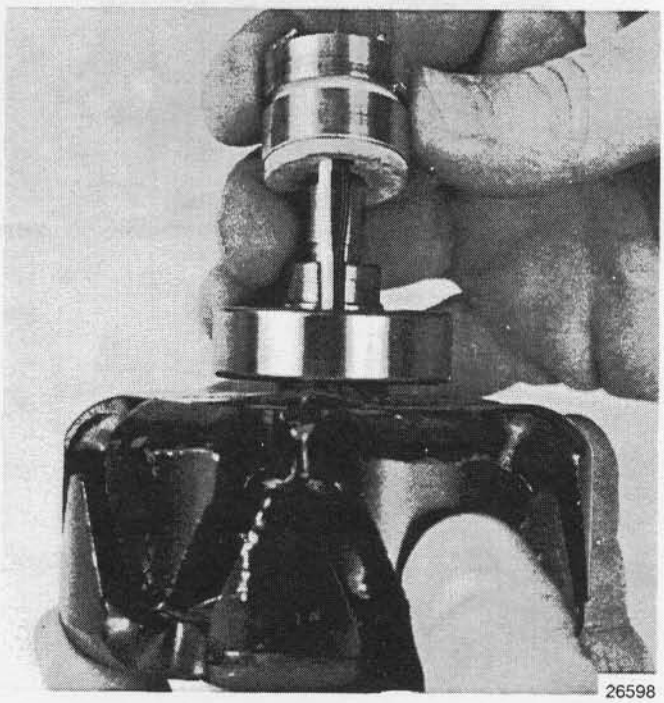


11591

a - Arbor Press
b - Bearing Driver (Must Contact Inner Bearing Race Only)
c - Support Pulley End of Shaft on Arbor Press Base (DO NOT Support Rotor on Pole Pieces)

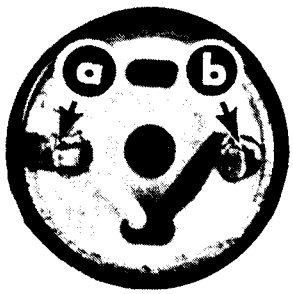
IMPORTANT: Be sure to support rotor on end of shaft and not on pole pieces, as pole pieces are only press-fit onto shaft.

2. Insert wires thru hole in slip rings as shown.


26598

IMPORTANT: Press on the center of slip rings only. Do not bend terminals or pinch wires.

3. Using an arbor press, install slip rings. Press on center of slip rings until they contact shoulder of rotor.
4. Carefully wrap white wire around outer slip ring terminal (a) and black wire around inner slip ring terminal (b). Solder wires in place.

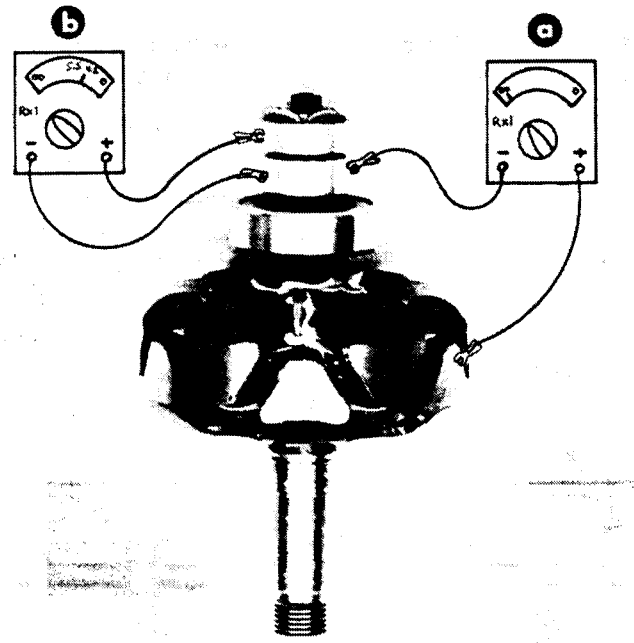


24777

Component Testing

Rotor

1. **TEST 1:** Test rotor field circuit for grounds, using an ohmmeter (set on Rx1 scale), as follows:
   a. Connect one lead of ohmmeter to either slip ring and the other lead to rotor shaft or pole pieces.
   b. Meter should indicate no continuity (meter should not move).
   c. If continuity does exist, rotor field circuit is grounded. Inspect slip ring terminals to be sure that they are not bent and touching rotor shaft. Also be sure that excess solder is not grounding terminals to rotor shaft. If cause for ground cannot be found, unsolder field winding leads from slip ring terminals and connect ohmmeter between one of the leads and rotor shaft or pole pieces. If continuity still exists, replace rotor assembly. If continuity is eliminated, replace slip rings.



11587

2. **TEST 2:** Test rotor field circuit for "opens," shorts or high resistance, using an ohmmeter (set on Rx1 scale), as follows:
   a. Connect one ohmmeter lead to each slip ring.
   b. Ohmmeter reading should be 4.1 to 4.7 ohms with rotor at room temperature [70°-80° F (21°-26° C)].
   c. If reading is high or infinite (no meter movement), high resistance or an "open" exists in the field circuit. Check for poor connections between field winding leads and slip ring terminals. If cause for "open" or high resistance cannot be found, connect ohmmeter directly to slip ring terminals. If correct reading is now obtained, replace slip rings. If reading is still high or infinite, replace complete rotor assembly.
   d. If reading is low, a short exists in the field circuit. Inspect slip rings to be sure that they are not bent and touching outer slip ring. Also be sure that excess solder is not shorting terminals to aft slip ring. If cause for short cannot be found, unsolder field winding leads from slip ring terminals and connect ohmmeter directly to leads. If correct reading is now obtained, slip rings are shorted and must be replaced. If reading is still low, rotor field windings are shorted, and complete rotor assembly must be replaced.

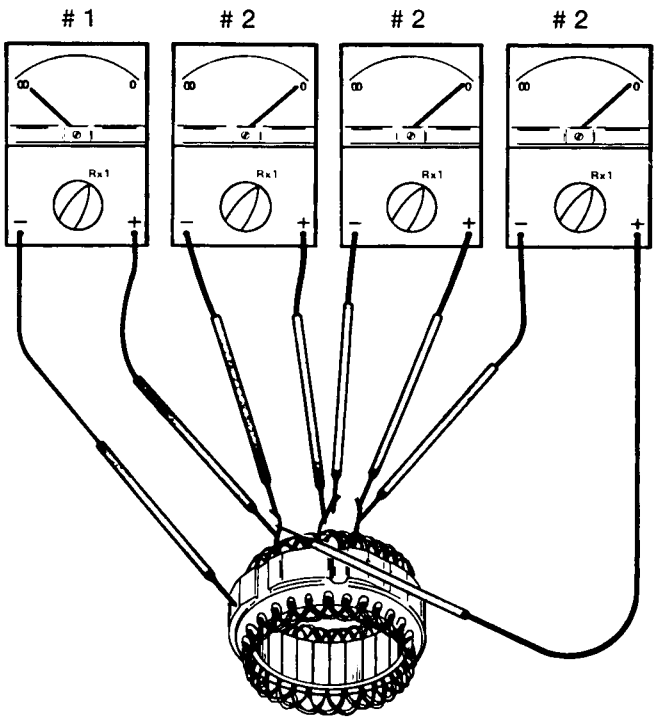
STATOR

IMPORTANT: Stator leads must be disconnected from rectifier diodes and diode trio for this test.

1. **TEST 1:** Test stator for "grounds," using an ohmmeter (set on Rx1 scale) as follows:

   a. Connect one lead of ohmmeter or test lamp to one of the stator leads and the other lead to stator frame. Be sure that lead makes good contact with frame.

      Meter should indicate no continuity (meter should not move). If continuity does exist, stator is grounded and must be replaced.



2. **TEST 2:** Test for "opens" in stator, using an ohmmeter (set on Rx1 scale) as follows:

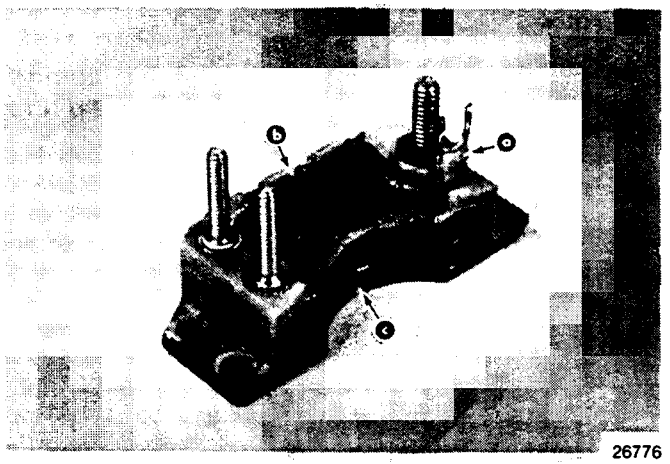
   a. Connect ohmmeter or test lamp between each pair of stator windings (3 different ways). Either of the 2 leads (coming from each stator windings) may be used.

      Continuity should be present in all 3 cases (meter should move); if it does not, one or more of the windings are open and stator must be replaced.

3. A short in the stator is difficult to detect without special equipment, because of the low windings resistance. If all other electrical components test out good, and alternator fails to produce rated output, stator probably is shorted and should be replaced. Also, examine stator for heat discolorations, as this usually is a sign of a short.

Rectifier Bridge/Diode Trio Assembly

Straighten strap (a) as shown. Pull diode trio (b) and rectifier bridge (c) apart.



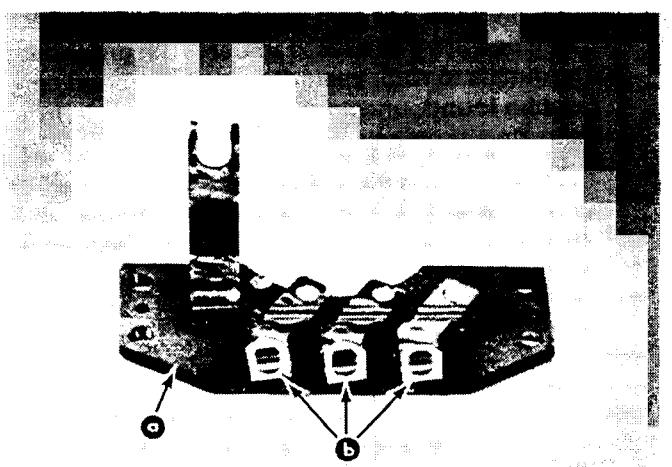
26776

⚠CAUTION
Do not use a test instrument with more than a 12-volt source (in the following test), as rectifier diodes may be damaged.

IMPORTANT: Rectifier diodes must be disconnected from stator for this test.

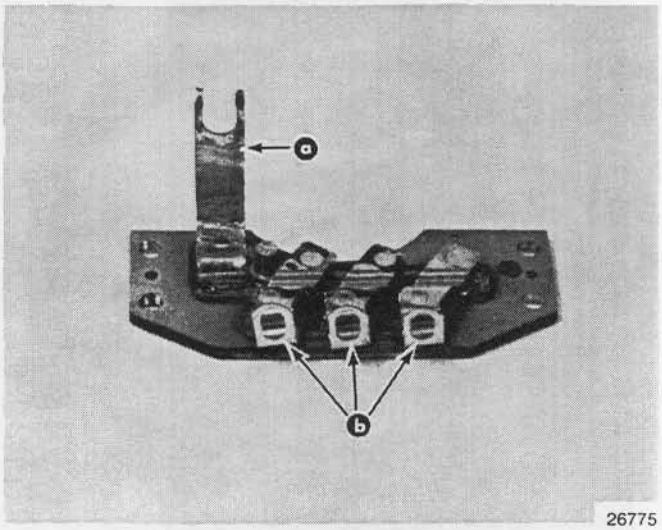
RECTIFIER BRIDGE

1. Using an ohmmeter (set on Rx1 scale), check for continuity between point (a) and each diode (b). Switch ohmmeter leads and recheck. Continuity should be observed in one direction (polarity) only, and all diodes should check alike.



26775

2. Using an ohmmeter (set on Rx1 scale), check for continuity between strap (a) and each diode (b). Switch ohmmeter leads and recheck. Continuity should be observed in one direction (polarity) only, and all diodes should check alike.

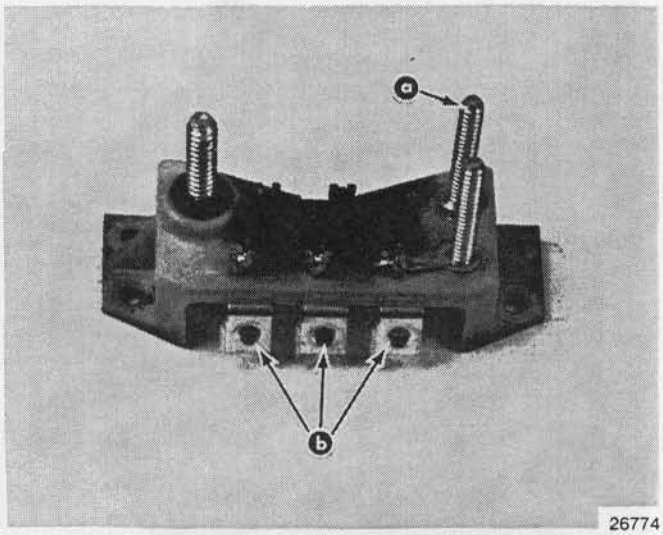


26775

If any diode is defective, replace entire rectifier bridge.

DIODE TRIO

1. Using an ohmmeter (set on Rx1 scale), check for continuity between stud (a) and each terminal (b). Switch ohmmeter leads and recheck. Continuity should be observed in one direction (polarity) only, and all diodes should check alike.



26774

If any diode is defective, replace entire diode trio.

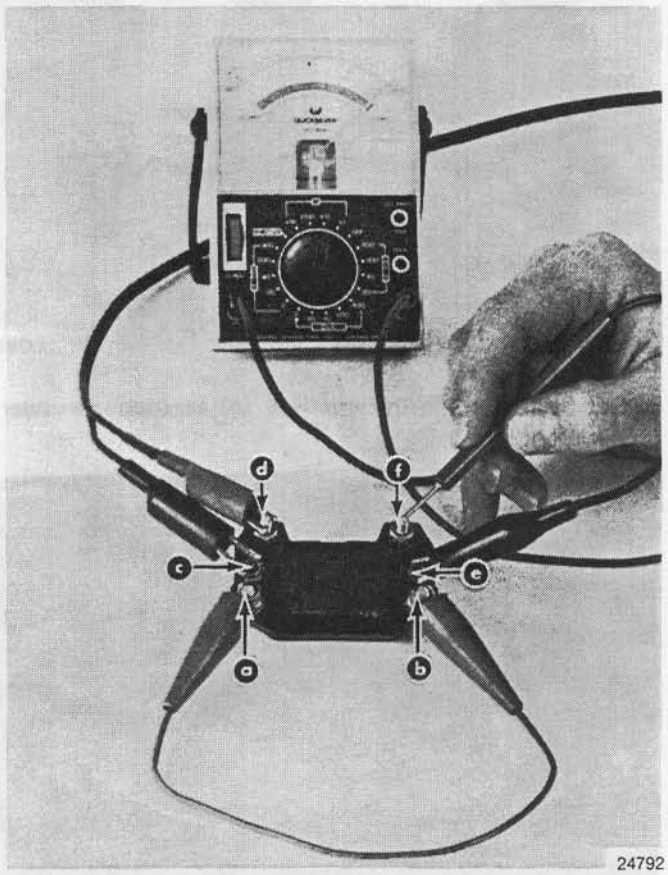
Condenser

1. Using Magneto Analyzer 91-76032 and accompanying instructions, perform the following condenser tests:
   a. Condenser Capacity Test (must be .5 mfd).
   b. Condenser Short or Leakage Test.
   c. Condenser Series Resistance Test.
2. Replace condenser, if test results are not within specifications.

Voltage Regulator Test

The voltage regulator can be tested using jumper wires, an ohmmeter and a variable voltage power supply (0-20 Volts DC).

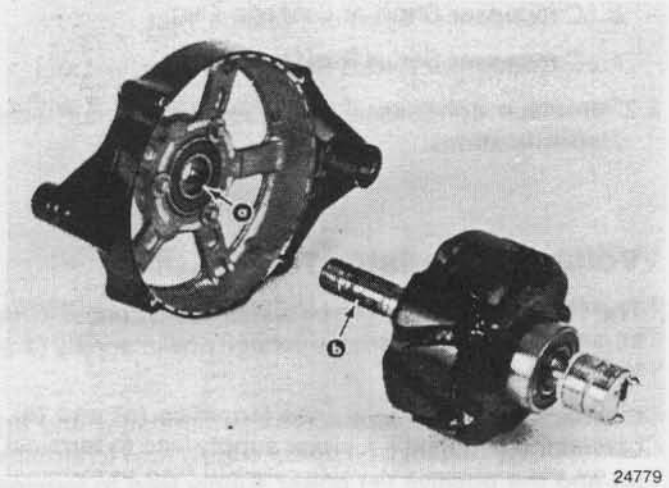
Connect a jumper wire across terminals (a) and (b). Connect the negative (-) power supply lead to terminal (c) and the positive (+) power supply lead to terminal (d). With the ohmmeter set on Rx10 scale, check for no resistance between negative terminal (e) and positive terminal (f) with power supply at less than 12 volts. Resistance should increase when voltage is increased to over 14 volts. If resistance doesn't increase, reverse ohmmeter leads and test again before determining that regulator is defective.



24792

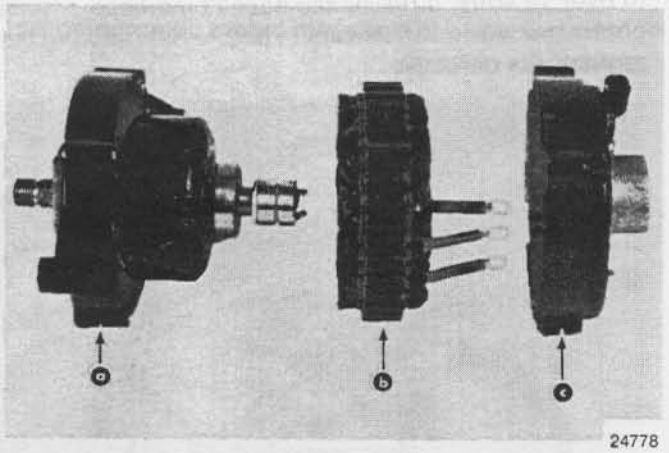
Assembly

1. Using an arbor press, install front housing with bearing (a) on rotor (b). Press only on center race of bearing until it contacts shoulder of rotor.



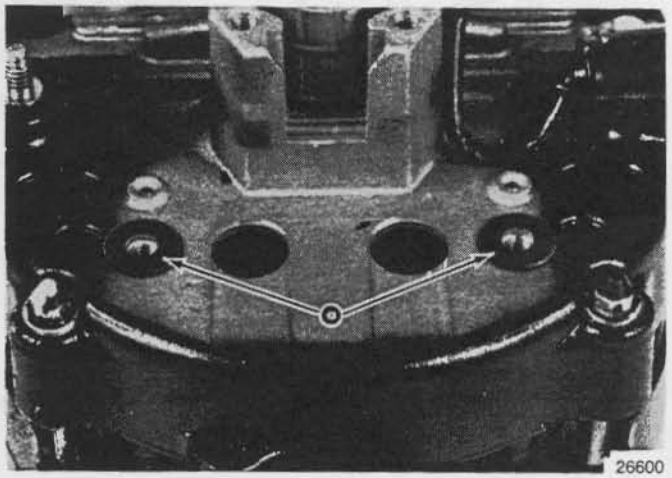
24779

2. Aligning marks made during disassembly, assemble front housing (a), stator (b) and rear housing (c). Tighten screws to 50-60 lb. in. (6 N·m).



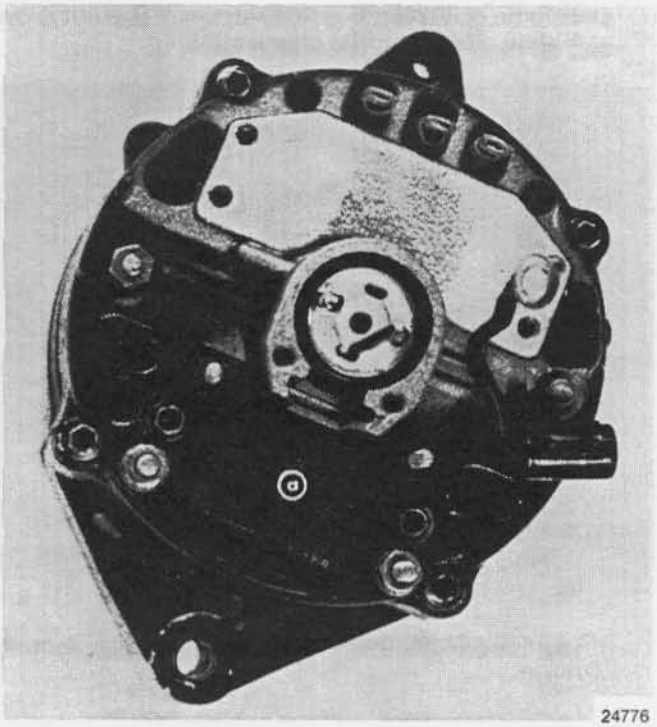
24778

3. Set fiber insulating washers (a) in place on rear housing.



26600

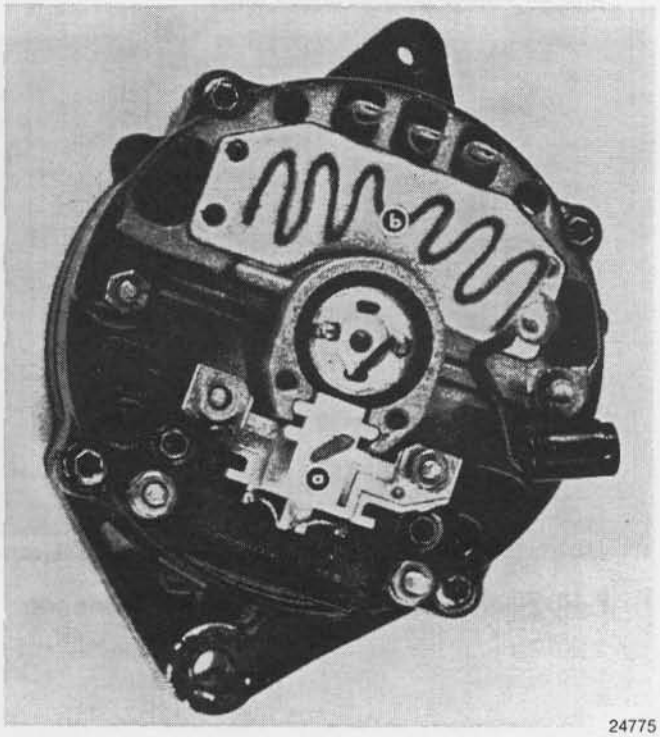
4. Install voltage regulator (a). Tighten screws securely.



24776

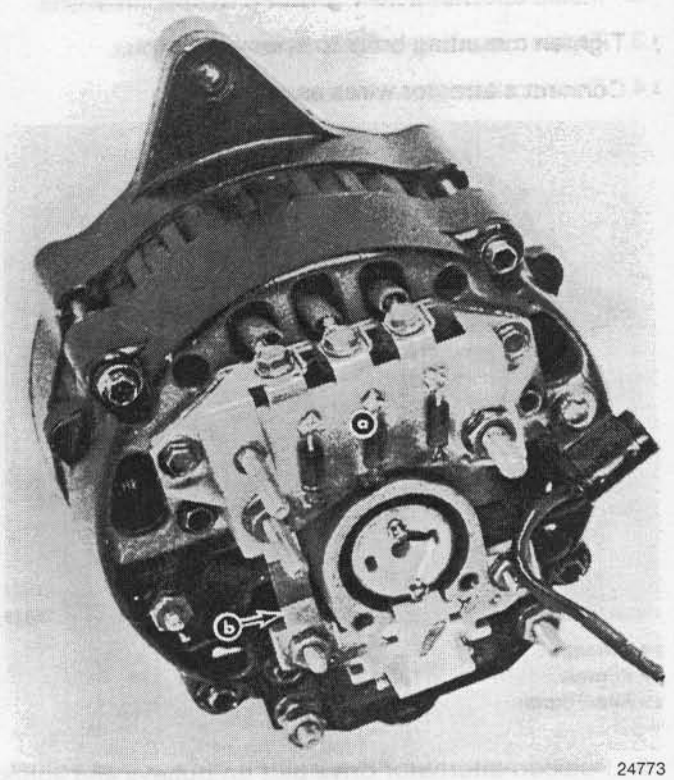
5. Install brush holder (a) with only right side mounting nut finger tight.

   Apply a thin coating of heat sink compound to housing (b).



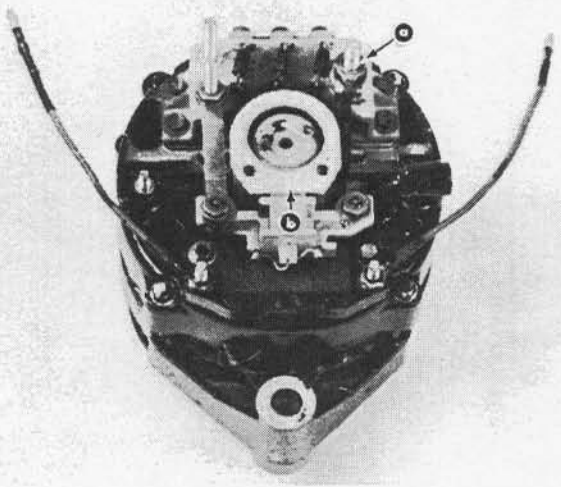
24775

6. Install diode trio/rectifier bridge assembly (a) and strap (b). Tighten mounting screws, stator screws and brush holder nuts securely.



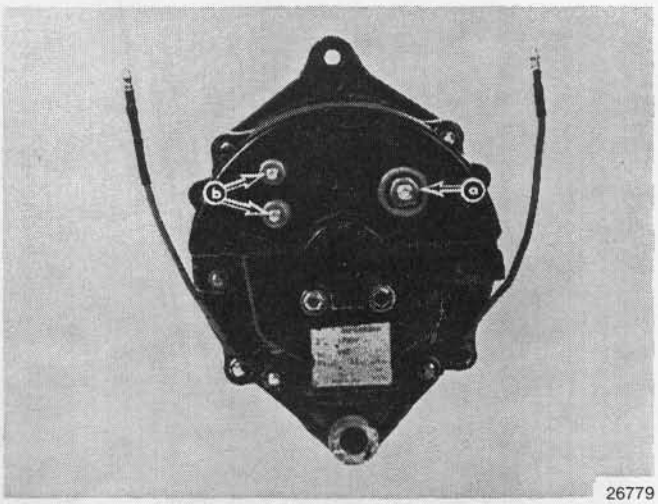
24773

7. Place condenser lead (a) on output terminal and felt gasket (b) on rear housing.



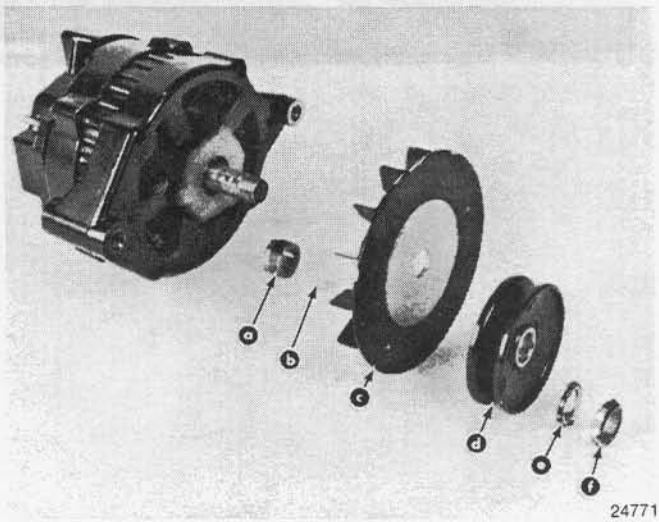
26781

8. Install cover, tighten screws securely.
9. Install insulator and nut on output terminal (a). Install nuts (b). Tighten all nuts securely.



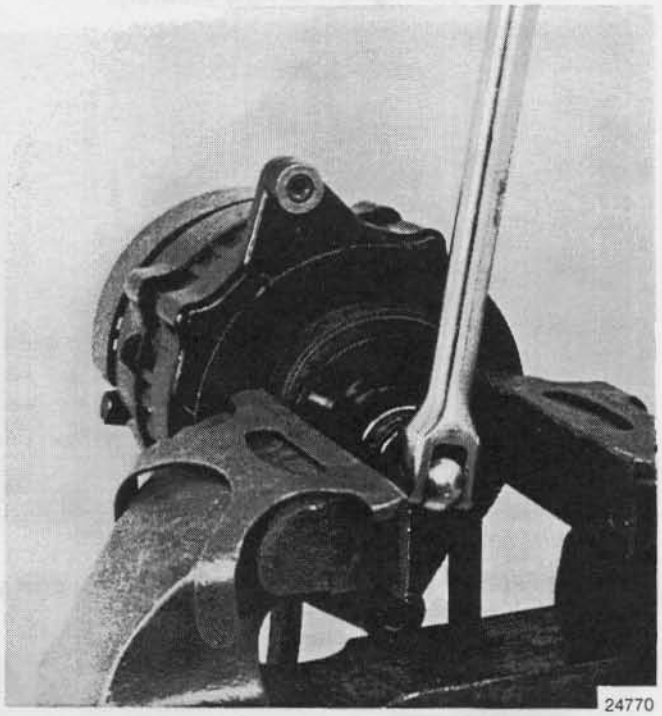
26779

10. Install spacer (a), woodruff key (b), fan (c), pulley (d), lock washer (e) and nut (f).



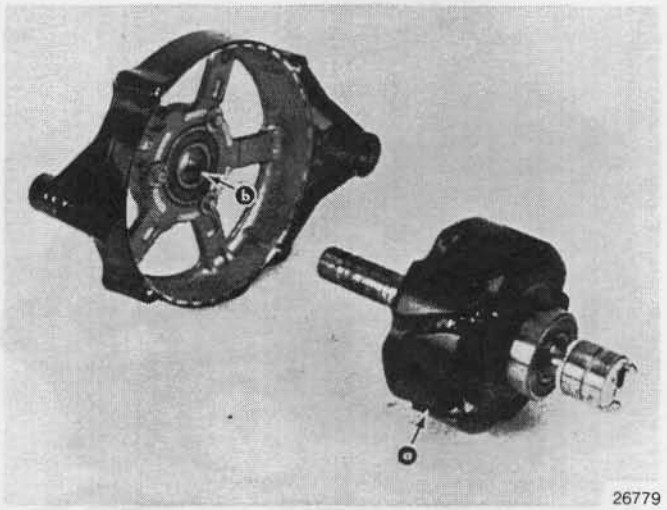
24771

11. Using an oversized belt to protect the pulley, clamp alternator in vise as shown. Tighten pulley nut to 35-50 lb. ft. (48-68 N·m).


24770

Installation

1. Install alternator on engine.
2. Install alternator belt. Tighten to specifications.
3. Tighten mounting bolts to specifications.
4. Connect alternator wires as shown.

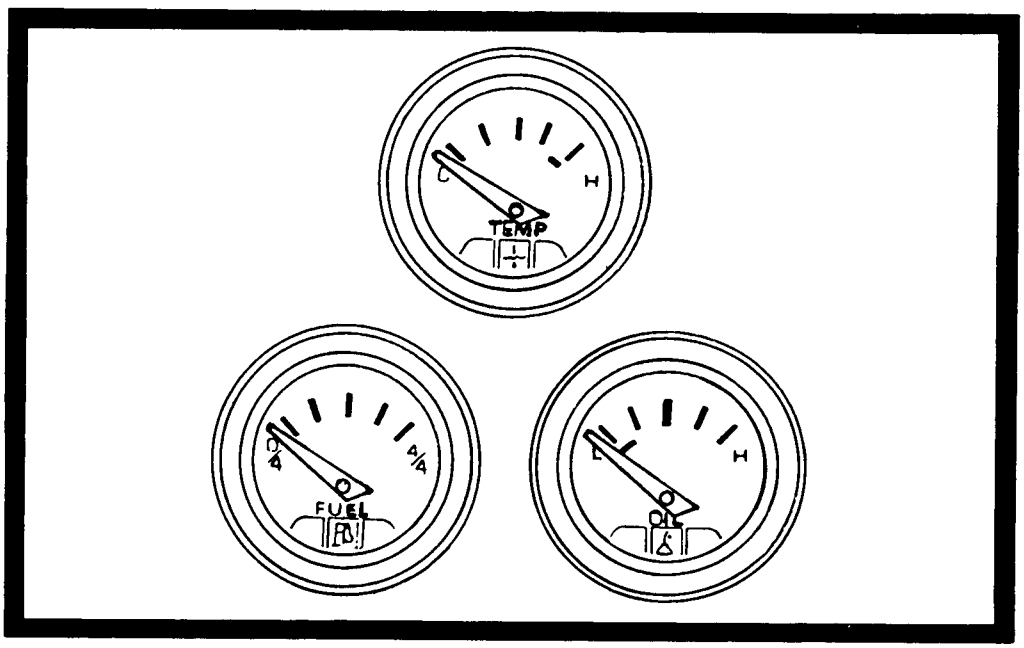


26779

a - Orange
b - Purple
c - Red/Purple

5. Position alternator drive belt on pulleys and adjust tension as explained under "Drive Belt Tension Adjustment."
6. Connect battery cables to battery.

ELECTRICAL SYSTEM



4

D

INSTRUMENTATION

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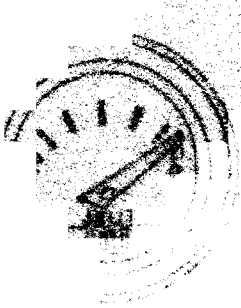


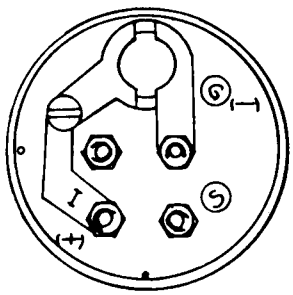
Gauges

Oil, Fuel and Temperature

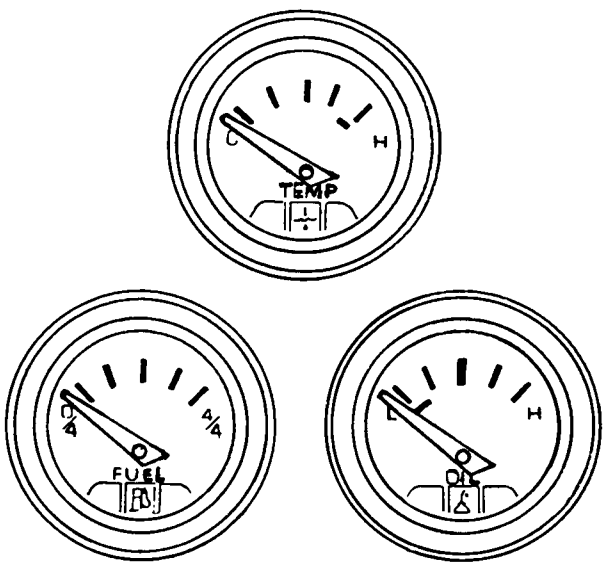
IMPORTANT: If testing proves gauge to be defective, it must be replaced as there is no repair available.

TESTING

1. Turn ignition switch "Off."
2. Remove wire from terminal "S."

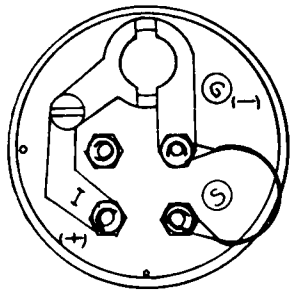


3. Turn ignition switch to "Run." Gauges must be at "A" position.

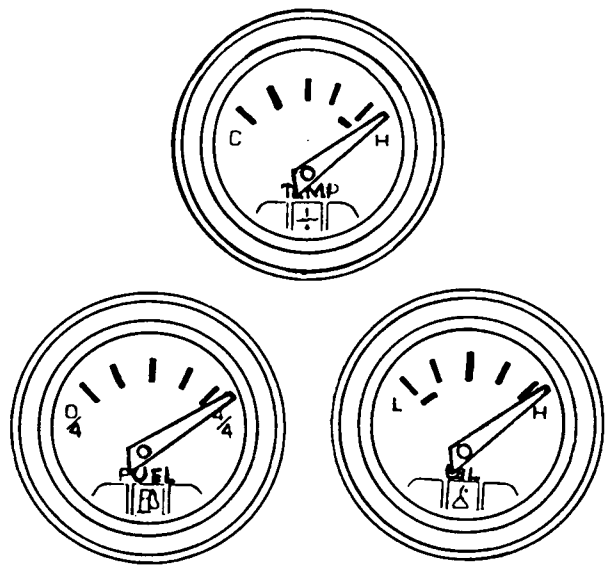


POSITION -A-

4. Turn ignition switch "Off."
5. Connect jumper wire from terminal "G" to terminal "S."



6. Turn ignition switch to "Run."
7. Indicator needle must read at "B." If not, replace gauge.

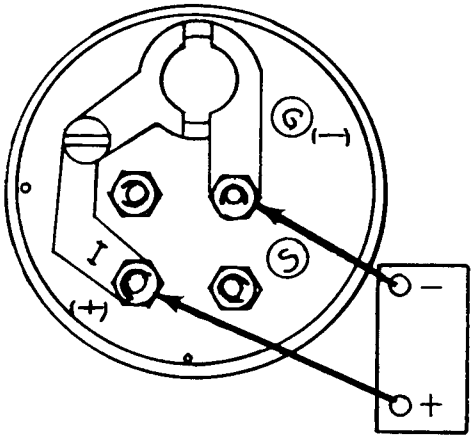


POSITION -B-

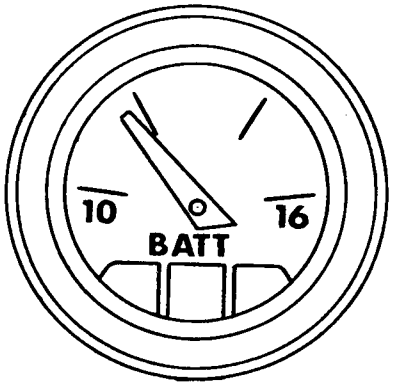
Battery Gauge

TESTING

1. Remove cables from battery and fully charge battery.
2. Connect negative (-) jumper lead from battery to gauge terminal "G."
3. Connect positive (+) jumper lead from battery to gauge terminal "I."



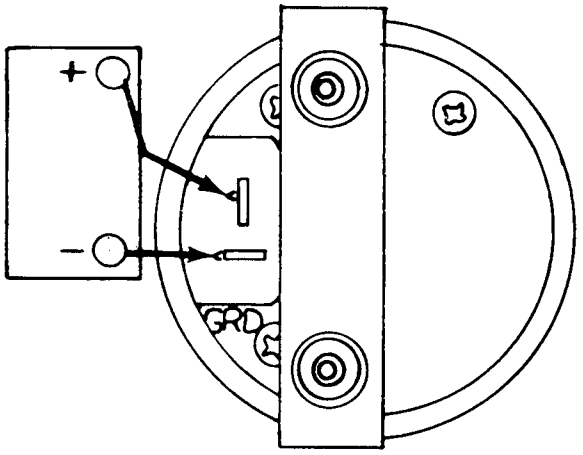
4. Check gauge reading, if not as shown replace gauge.



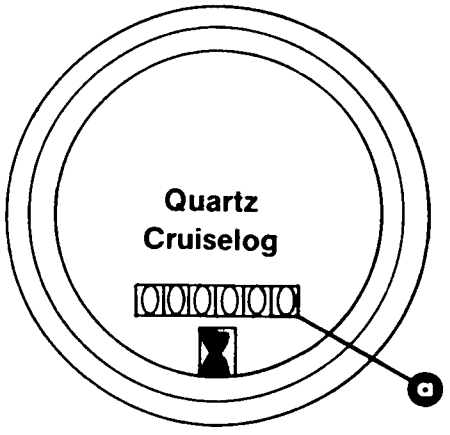
Cruiselog Meter

TESTING

1. Connect jumper wire from negative (-) battery terminal to negative (-) gauge terminal.
2. Connect jumper wire from positive (+) batttery terminal to positive (+) gauge terminal.



3. Observe gauge run indicator, if it is turning gauge is operable, if not replace gauge.



a - Run Indicator

Vacuum Gauge

TESTING

1. Disconnect vacuum hose from engine. Connect service vacuum gauge to engine and record engine vacuum readings at idle, 1000, 2000 and 3000 RPM. Reconnect vacuum hose and compare vacuum gauge readings (at specified RPM) with service gauge readings. Readings should be within 3 inches of vacuum of each other.

IMPORTANT: Make sure that vacuum hose between gauge and engine is not leaking and that all connections are tight.

Speedometer

TESTING

IMPORTANT: When testing speedometer gauge for accuracy, air pressure that is used for test must be regulated to specified PSI. Do not apply excessive air pressure to speedometer gauge.

1. Apply air pressure directly to speedometer gauge (specified in chart) and note gauge reading. Light tapping of pressure gauge is required during accuracy check.
2. If gauge readings are not within specifications, gauge is defective.

CALIBRATION CHART

Air Pressure Gauge PSI	Speedometer Gauge MPH
5.3	20 ± 2 (32km/hr ± 1.6)
27.8	45 ± 1 (72km/hr ± 1.6)

Tachometer

TESTING

1. Connect a service tachometer to engine and compare readings.
2. Replace if not within specifications.

TACHOMETER TYPE	ALLOWABLE RANGE
6000 RPM	± 150 RPM
8000 RPM	± 200 RPM

Gauge Replacement

1. Disconnect battery cables from battery.
2. Remove wires from back of gauge.
3. Remove hose (vacuum, speedometer gauge).
4. Disconnect light socket.
5. Remove holding strap and remove gauge.
6. Position gauge assembly in appropriate mounting hole.
7. Install holding strap and nuts. Tighten nuts evenly and securely.

IMPORTANT: Do not distort case or bracket by overtightening.

8. Connect ground (black) wire to ground terminal, if gauge is not mounted in metal panel.
9. Connect other wires to gauge as shown in "Section 3, Part F."
10. Connect hoses (vacuum, speedometer gauges).
11. Install gauge light socket.
12. Coat all terminals with Liquid Neoprene.
13. Reconnect battery cables to battery.

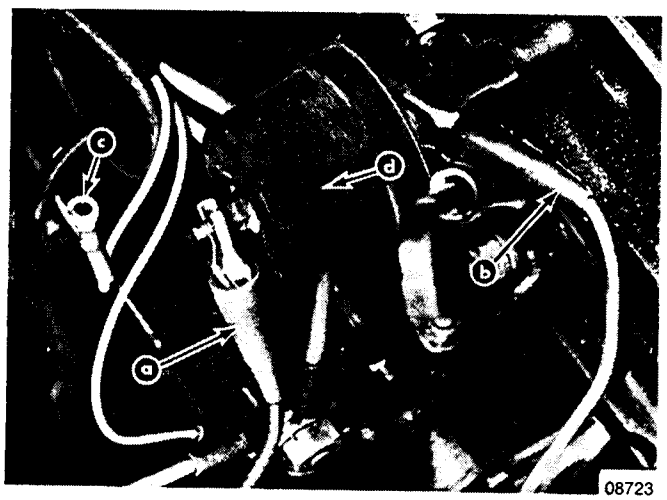
Senders

Oil Pressure

TESTING

IMPORTANT: Use following test procedure for checking accuracy of oil pressure sender only. If oil pressure gauge indicates zero oil pressure, refer to "Trouble-shooting" section.

1. Remove wire from sender terminal.
2. Connect ohmmeter between sender terminal and sender case. Check ohms reading without engine running (zero pressure), then check reading with engine running. Compare oil pressure and ohms readings as shown in following chart:



08723

a - Positive Lead
b - Negative Lead
c - Wire Removed
d - Oil Pressure Sender

Oil Pressure (Lb./Sq. In.)	Ohms Reading Single	Dual
0	227 - 257	113.5 - 128.5
20	142 - 162.5	71 - 81.25
40	91.7 - 113.6	45.8 - 56.8
80	9 - 49	4.5 - 24.5

Dual Station Sender Identification

Sender will have 353-AM stamped on hex of sender.

Water Temperature

There is no test for sender, install new sender.

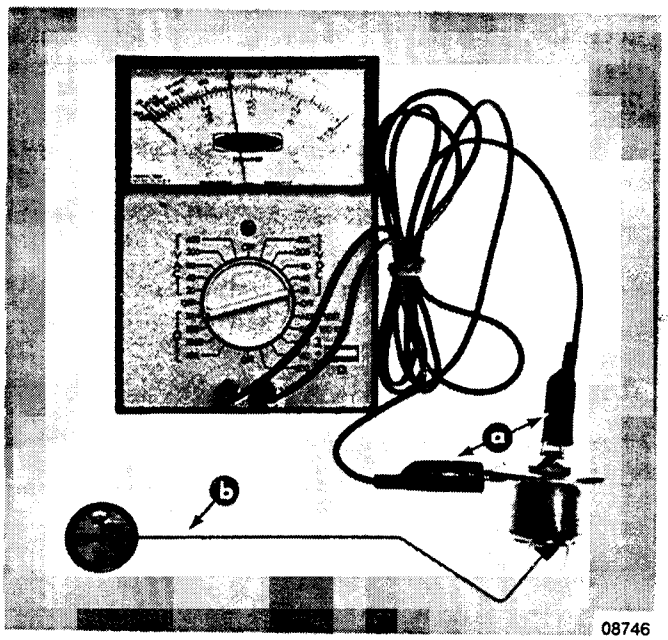
Dual Station Sender identification sender will have 362-BC stamped on hex.

Fuel Tank Sender

FLANGE TYPE

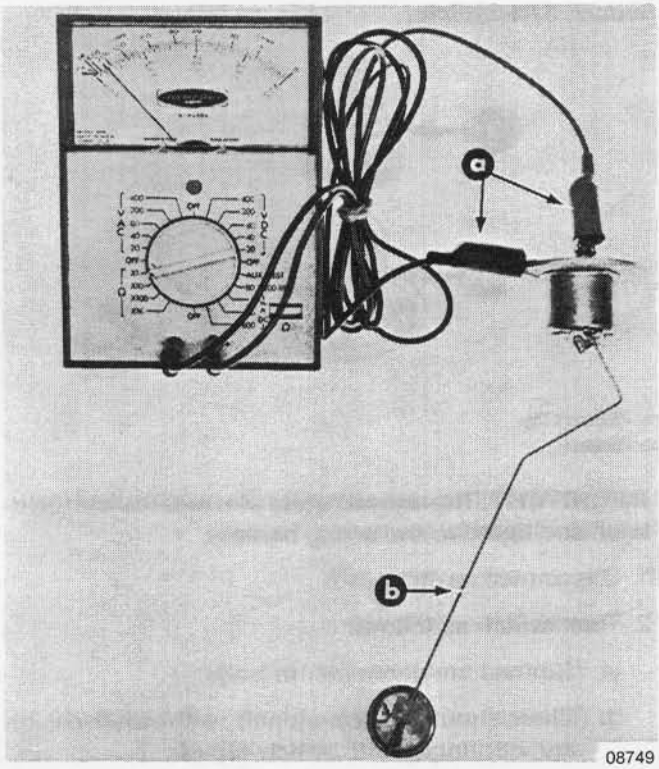
Testing

1. Disconnect wire from terminal on sending unit and ground wire from sending unit mounting screw.
2. Remove sending unit from fuel tank.
3. Connect ohms meter between sending unit terminal and sending unit housing.
4. With float arm in "full" position (arm horizontal), ohmmeter should read 30 ohms (± 5 ohms).



08746

5. With float arm in "empty" position (arm vertical) meter should read 240 ohms (± 5 ohms). Sender is defective if not within specifications.

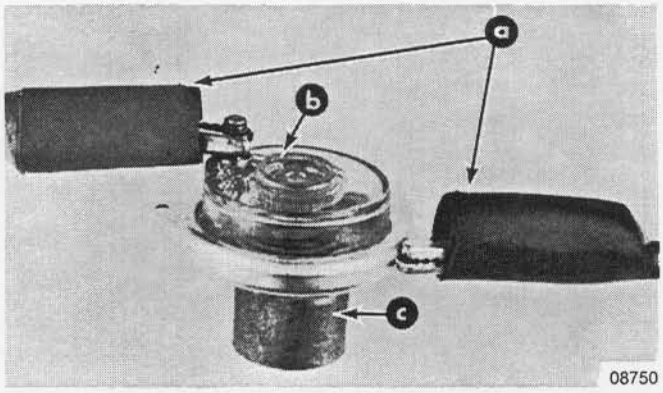


a - Ohmmeter Leads
b - Vertical Float Arm

CAPSULE TYPE

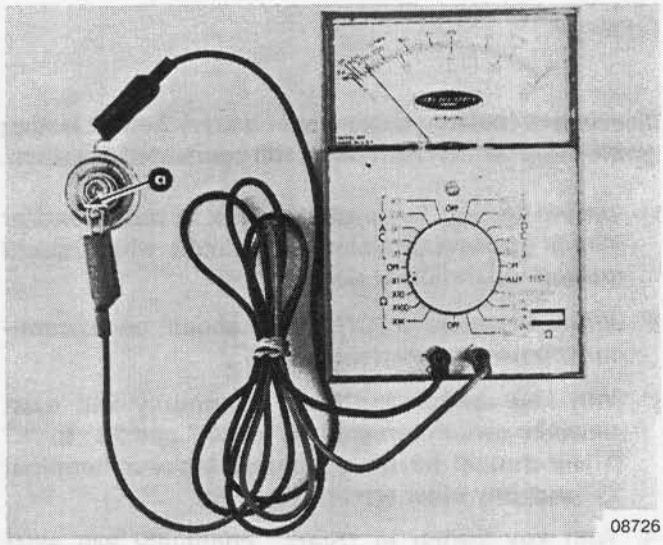
Testing

1. Disconnect wire from terminal on fuel tank capsule.
2. Remove 2 screws and remove capsule assembly.
3. Place a magnet under fuel capsule.
4. Connect ohmmeter between fuel capsule terminal and metal portion of capsule housing.



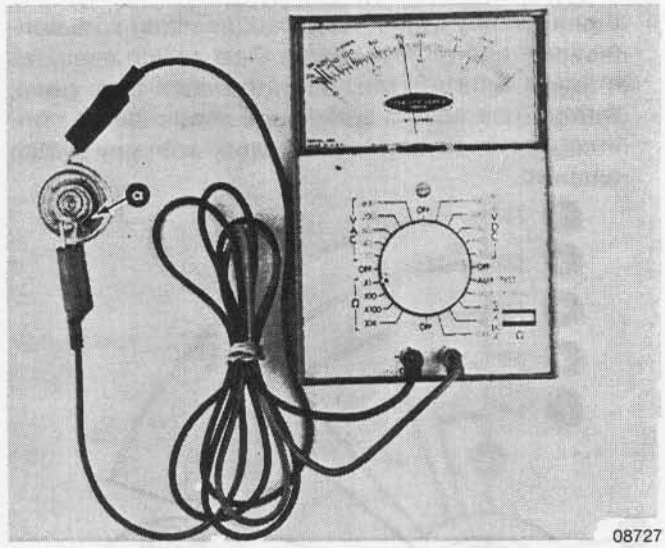
a - Ohmmeter Leads
b - Capsule Assembly
c - Magnet

5. Turn magnet counterciockwise until fuel capsule indicator reads empty. Ohmmeter should read 240 ohms (± 5 ohms).



a - Capsule Reading Empty

6. Turn magnet clockwise until fuel capsule indicator reads "Full." Ohmmeter should read 30 ohms (± 5 ohms). Fuel capsule is defective if not within specifications.



a - Capsule Reading Full

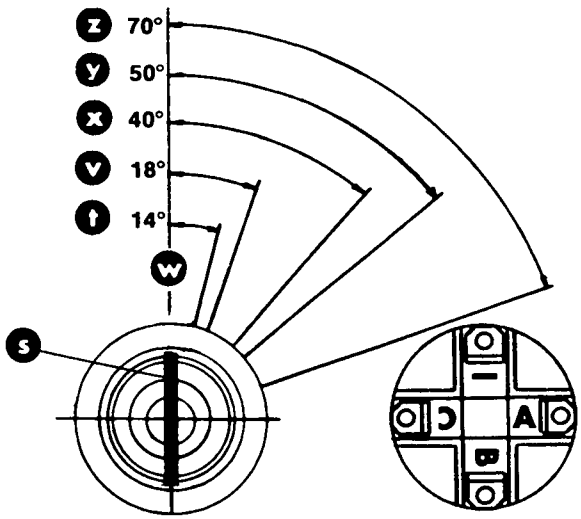
Switches

Ignition Key Switch

Testing

Disconnect battery cables from battery before testing ignition key switch with wires still connected to switch.

1. Before testing key switch, check all fuses and/or circuit breakers in electrical circuit which could prevent operation of starter.
2. With key switch in "Off," there should be no continuity between switch terminals.
3. With key switch in "Run," continuity will exist between switch terminal "B" to "A" and "B" to "I." There should be no continuity between terminal "C" and any other terminals.
4. With key switch in "Start," continuity will exist between terminal "B" to "A," "B" to "I" and "B" to "C."
5. Terminals are to make contact at angles shown and to stay in contact condition as switch is rotated toward "Start."
6. If ignition key switch tests bad, unsolder wire connections and remove switch. Test switch again, as in Steps 2-thru-5, preceding. If switch tests good, wiring in harness is bad. There should be no continuity between any harness wires with key switch removed.

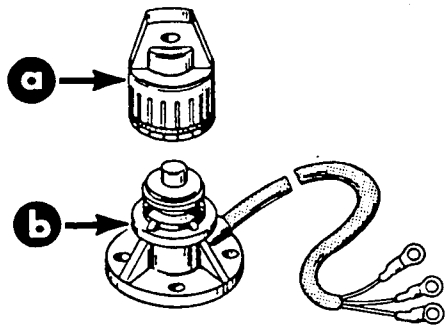


S - Key
W - Off
T - Continuity, B-A Terminals
V - Continuity, B-I Terminals
X - Run
Y - Continuity, B-C Terminals
Z - Start

Lanyard Stop Switches

TESTING

Button Style Switch

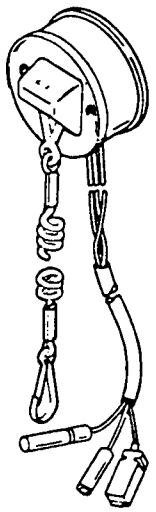


a - Switch Cap
b - Switch

IMPORTANT: The unused white wire must be well insulated and taped to the wiring harness.

1. Disconnect switch leads.
2. Test switch as follows:
   a. Connect an ohmmeter to leads.
   b. There should be no continuity with switch cap on and continuity with switch cap off.

Toggle Style Switch



IMPORTANT: The black/yellow lead is not used. It should be well insulated and taped to harness.

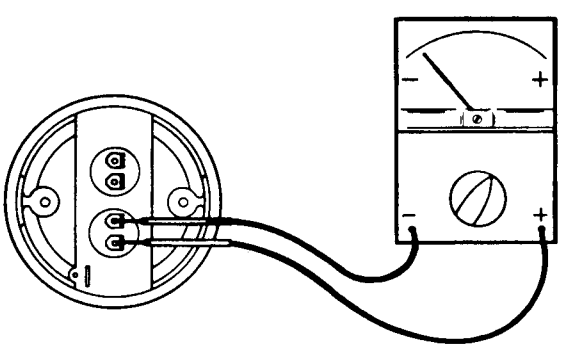
1. Disconnect switch leads.
2. Connect an ohmmeter to switch leads.
3. Switch should have continuity with toggle in the Run position and no continuity with toggle in the Off position.

Start/Stop Switch

TESTING

⚠WARNING
Disconnect battery leads at battery before testing.

1. Disconnect battery leads.
2. Check for continuity between the terminals on the start switch with a continuity meter.



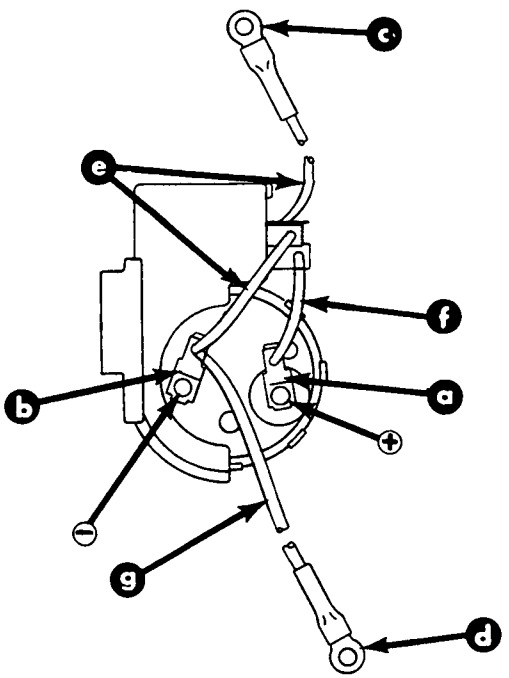
3. No continuity should exist.
4. Depress switch button and continuity should exist.
5. Check stop switch in the same manner.
6. If continuity exists when in the open (not depressed) state, replace panel button.

Audio Warning System

Buzzer

TESTING

1. Turn key to "Run" position (engine off).
2. Wait 7 to 14 seconds for horn to sound.
3. If horn does not sound:
   a. Connect jumper wires as shown.
   b. If horn does not sound, replace it.
4. If horn worked in step 3:
   a. Connect jumper wires as shown.
   b. Repeat step 2.
   c. If horn sounds, problem is in tan/blue wire back to engine or switches on engine.

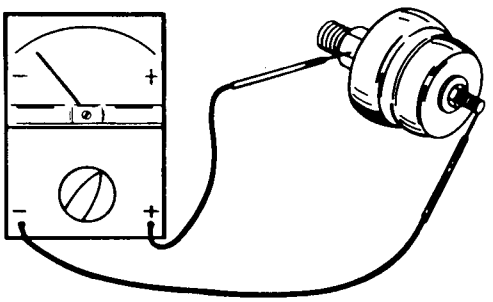


a - Jumper Wire to 12-V (+) — STEP 3
b - Jumper Wire to Ground (-) — STEP 3
c - Jumper Wire to 12-V (+) — STEP 4
d - Jumper Wire to Ground (-) — STEP 4
e - Purple Wire
f - Red Wire
g - Tan/Blue Wire

Oil Pressure Switch

TESTING

1. Remove wire from sender terminal.
2. Connect continuity meter between sender terminal and sender hex.



3. With engine not running, meter should indicate full continuity.
4. Start engine. With engine running and engine oil pressure above 6 PSI (41 kPa), meter should indicate NO continuity.

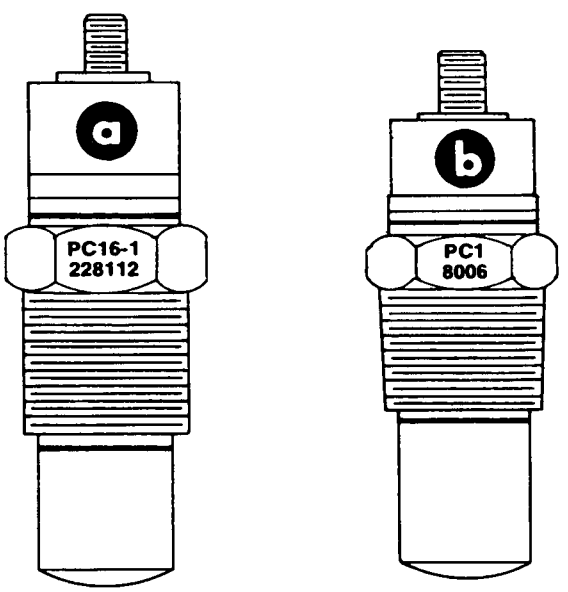
SWITCH IDENTIFICATION

Switch has 364-AF stamped on hex of sender.

Water Temperature Switch

Switch is normally open.

Switch Identification



a - 48952 Switch with Red Mylar Sleeve
b - 87-86080 Switch with Black Mylar Sleeve

48952 SWITCH	
Opens	150° F - 170° F (66° C - 77° C)
Closes	190° F - 200° F (88° C - 93° C)

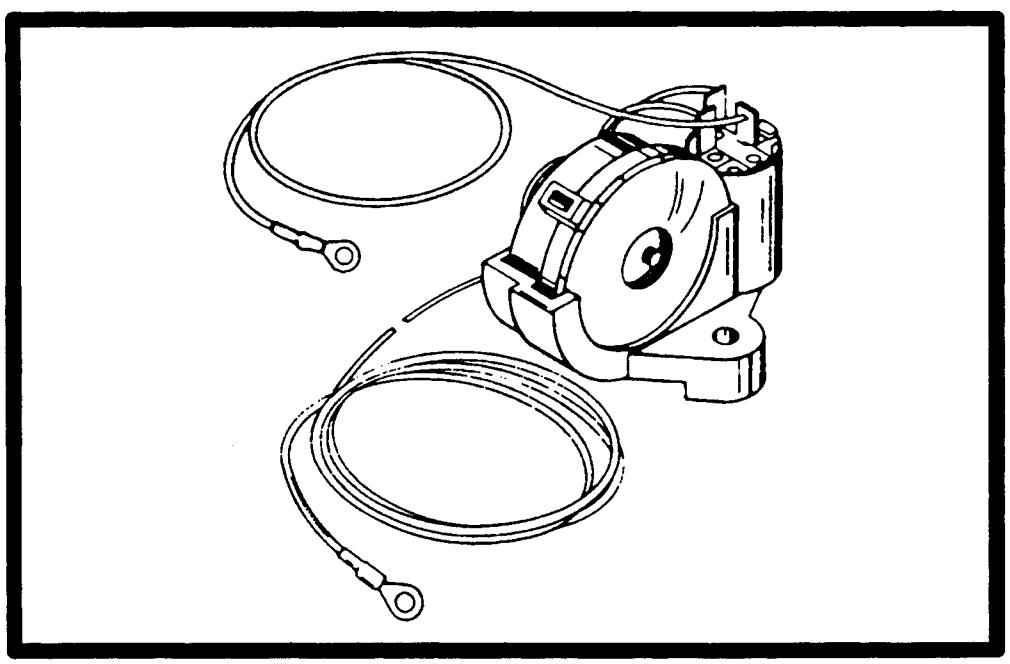
87-86080 SWITCH	
Opens	175° F - 195° F (79° C - 91° C)
Closes	215° F - 225° F (102° C - 107° C)

Transmission Fluid Temperature Switch

Switch is located on transmission. Switch is normally open. This switch is used on MCM 330 (B-W) and MIE 230/260/340 engines.

87-88031 SWITCH	
Opens	180° F - 200° F (82° C - 93° C)
Closes	220° F - 240° F (104° C - 116° C)

ELECTRICAL SYSTEM



4

E

ELECTRICAL KITS

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Wiring Color Code for MerCruiser Products

BLK = Black
BLU = Blue
BRN = Brown
GRY = Gray
GRN = Green
ORN = Orange
PNK = Pink
PUR = Purple
RED = Red
TAN = Tan
WHT = White
YEL = Yellow
LIT = Light
DRK = Dark

Lanyard Stop Switches

⚠ WARNING

Disconnect battery leads at battery before attempting to install ignition safety stop switch.

⚠ CAUTION

This stop switch is to be used as a safety stop switch only. It should not be used as the normal engine shut-off.

⚠ WARNING

As we cannot possibly know of and advise the boating public of ALL conceivable boat/motor types and/or poor operating practices, the final decision of whether to install and use a LANYARD STOP SWITCH, rest with the owner/driver.

⚠ CAUTION

Before cutting any holes in dashboard, check area behind dashboard for obstructions (braces, cables, etc.).

65503A 2 Kit

INSTALLATION INFORMATION

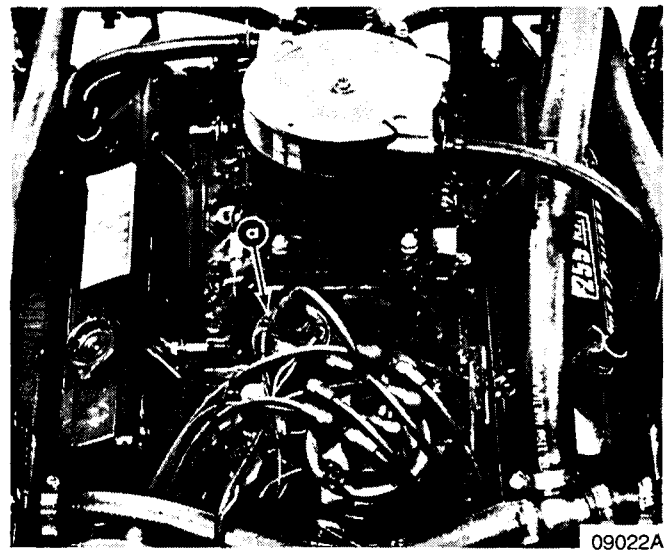
1. Route stop switch wire harness to engine so that it will not chafe or flex unnecessarily. Secure harness with sta-straps provided.
2. Check stop switch operation after installation is completed.
3. Coat all electrical connections with Liquid Neoprene after checking switch operation.
4. Attach stop switch cap to operator's person with a suitable cord (lanyard). Length of cord should be no longer than absolutely necessary and should have a minimum breaking strength of 100 lbs. (45 kg).

IMPORTANT: To prevent the possibility of damage to ignition components, turn ignition switch to "OFF" position as soon as possible after safety stop switch has been activated.

5. To reset stop switch after activation, simply install stop switch cap with a straight firm push.

MERCRUISER ENGINES WITH BREAKER POINT IGNITION

1. Tape white stop switch harness lead to harness and insulate with at least two layers of electrical tape.
2. Connect black stop switch harness lead to ignition coil negative (-) terminal along with existing wires.



a - Negative (-) Coil Terminal

Wire Location (Typical 8-Cylinder MerCruiser Engine with Breaker Point Ignition)

3. Connect green stop switch harness lead to convenient engine ground.
4. Coat connections with Liquid Neoprene.

87-19674A 2 or 87-814324A 2 Kit

INSTALLATION INFORMATION

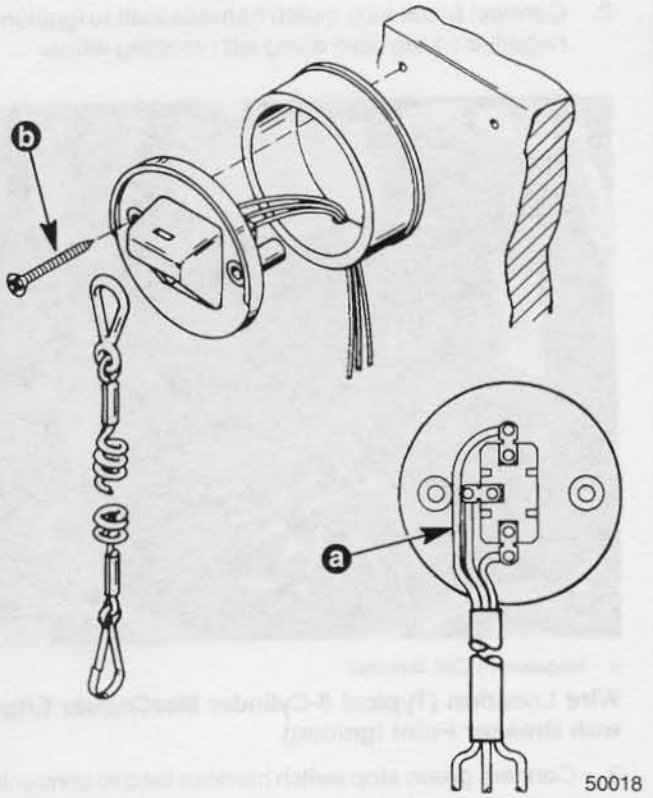
1. Select a location for lanyard stop switch that will allow lanyard to be pulled free without interference and will be within wire length limitations.
2. Mark hole locations for flush or surface mounting. Install switch assembly as shown.

IMPORTANT: If using "Surface Mounting" configuration (as shown following), ensure wires are routed to the outside as shown, to prevent pinching if wires between the back of switch and the mounting surface.

DRILLING TIPS

If dashboard is fiberglass, apply masking tape to area that is to be drilled to prevent dashboard from cracking.

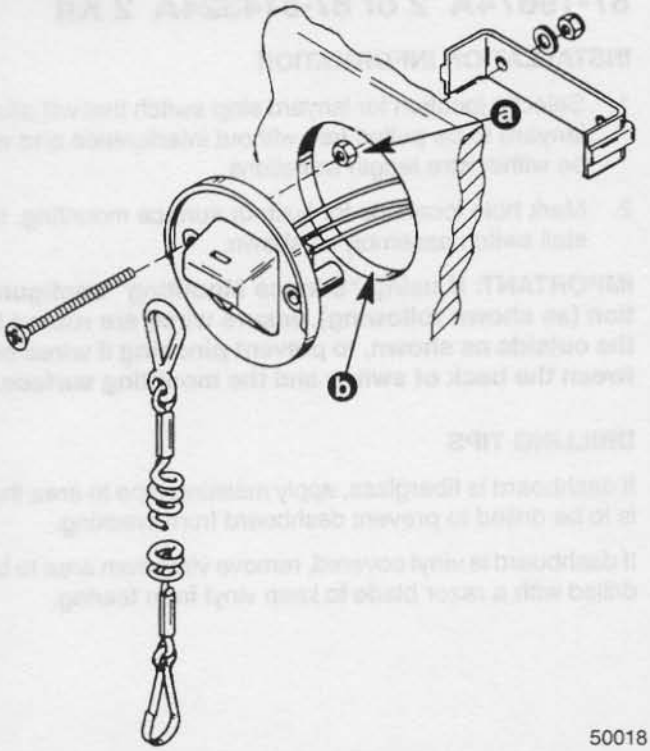
If dashboard is vinyl covered, remove vinyl from area to be drilled with a razor blade to keep vinyl from tearing.



50018

a - Wires Properly Routed
b - Self-Tapping Screw - Drill Pilot Hole Using Appropriate Drill:
Aluminum - 5/32 in. (4 mm)
Wood/Fiberglass - 11/64 in. (4.5 mm)

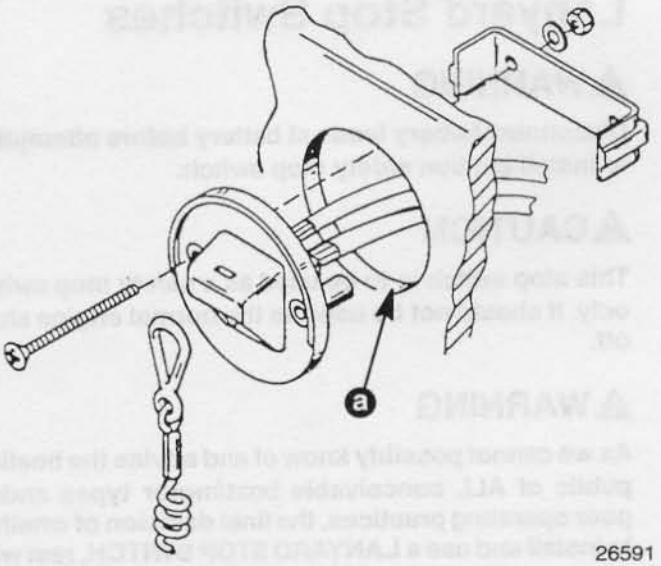
Surface Mount - Single Engine



50018

a - Secure Mounting Screws with Nuts to Aid Installation
b - 2-1/8 in. (54 mm) Hole - Use Hole Saw

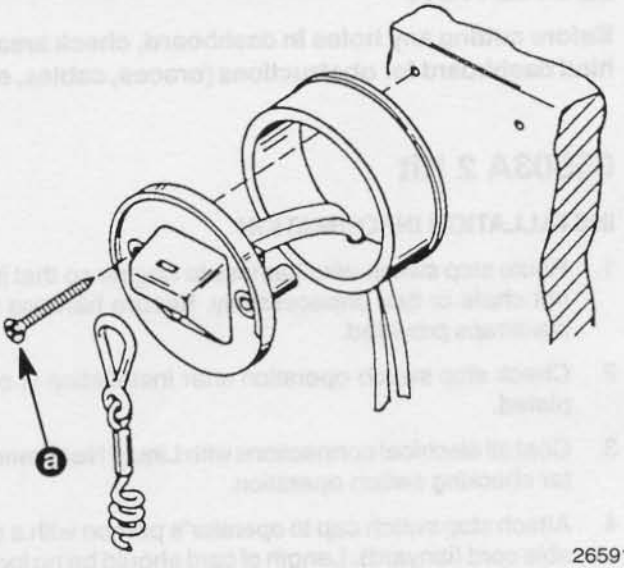
Flush Mount - Single Engine



26591

a - 2-1/8 in. (54 mm) Hole

Flush Mount - Dual Engines



26591

a - Self-Tapping Screw - Drill Pilot Hole Using Appropriate Drill:
Aluminum - 5/32 in. (4 mm)
Wood/Fiberglass - 11/64 in. (4.5 mm)

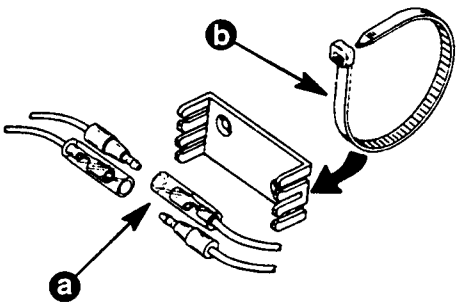
Surface Mount - Dual Engines

IMPORTANT: Be sure to refer to appropriate wiring diagram in the following step.

IMPORTANT: Lanyard Stop Switch installed at second station (flybridge) must use Extension Harness Kit (P/N 84-16866A2) to connect switch to wiring harness at main (lower station. Refer to instructions in extension harness kit.

3. Connect lanyard stop switch wires in accordance with appropriate wiring diagram. Route switch wires to prevent possible chafing or flexing during boat operation. Secure wires with sta-straps.

4. Secure bullet connectors with retainer and sta-straps.



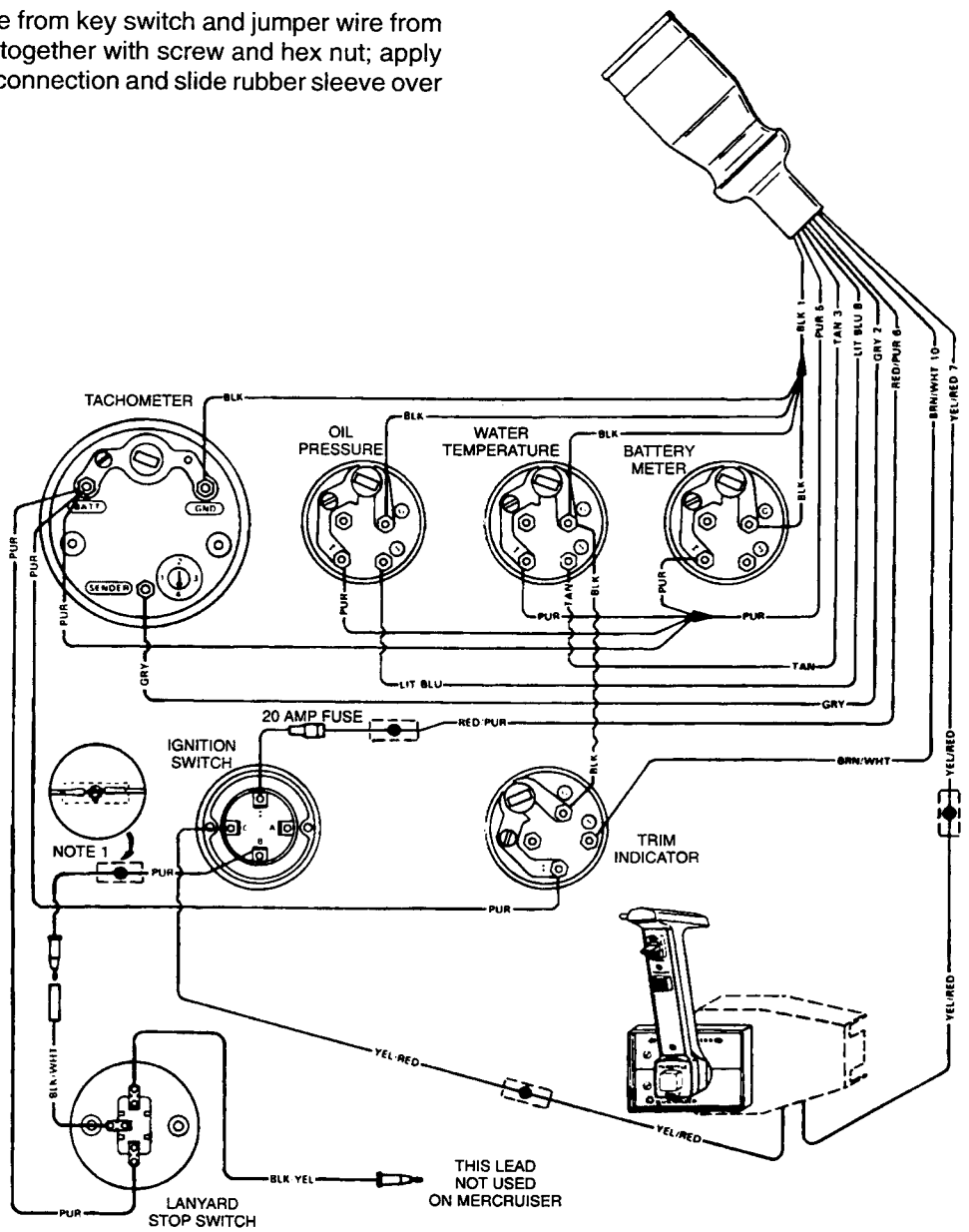
24907

a - Join Connectors
b - Secure with Sta-Strap

5. When installation is complete, reconnect battery leads at battery and perform operational test.

MerCruiser Wiring Diagram - Single Engine

NOTE 1: (PUR wire from key switch and jumper wire from kit) Connect wires together with screw and hex nut; apply liquid neoprene to connection and slide rubber sleeve over connection.

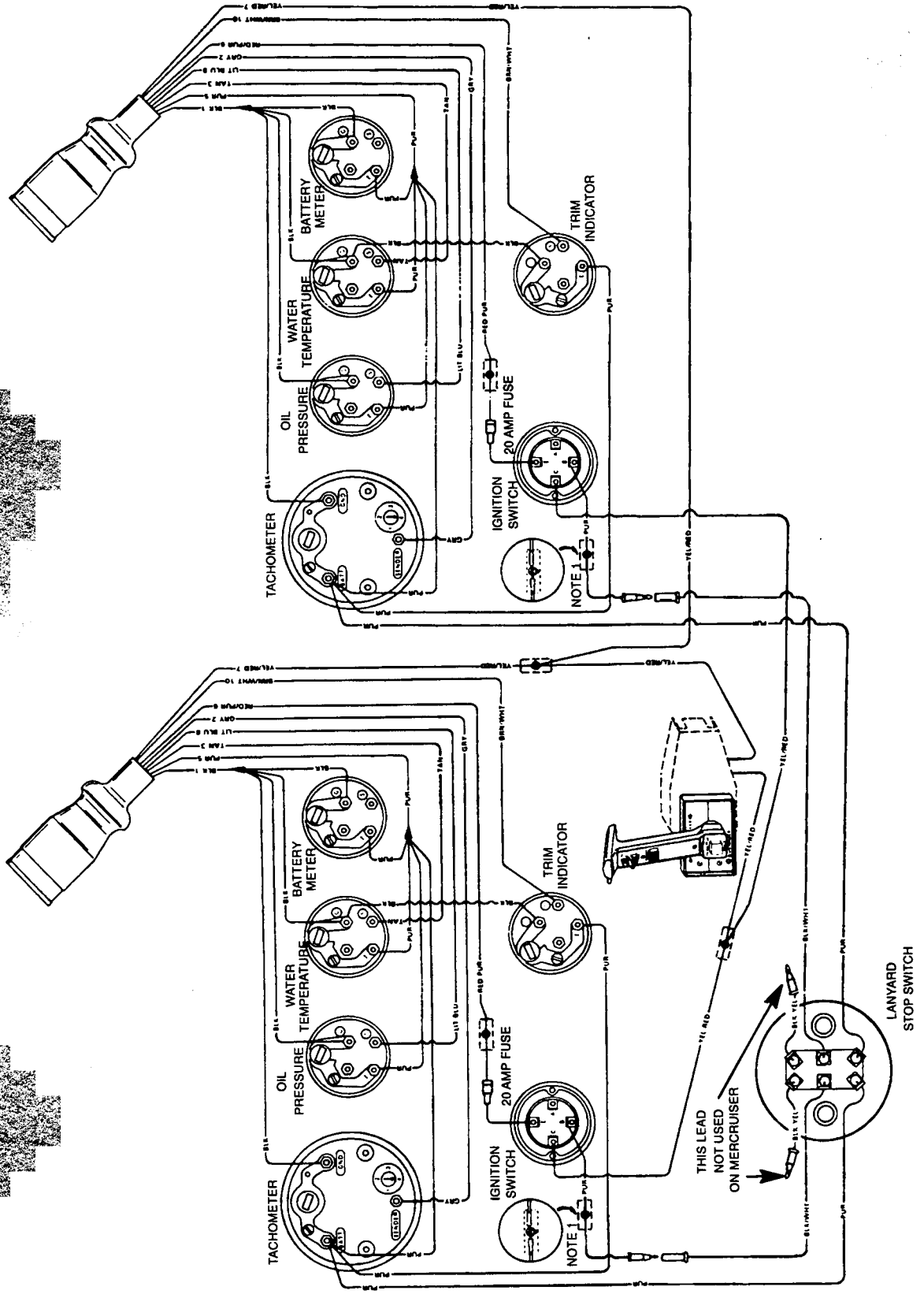


50019

MerCruiser Wiring Diagram - Dual Engines

NOTE 1: (PUR wire from key switch and jumper wire from kit) connect wires together with screw and hex nut; apply liquid neoprene to connection and slide rubber sleeve over connection.

IMPORTANT: On installations where gauge options will not be used, tape back and isolate any unused leads.



Audio Warning System

⚠WARNING

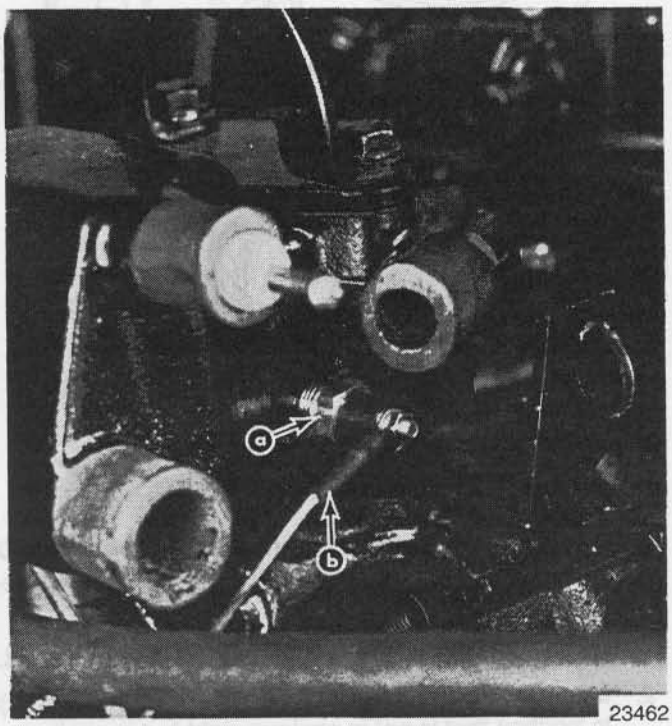
Always disconnect battery cables from battery before working around electrical system components to prevent injury to yourself or damage to electrical system.

86047A 14 Kit

INSTALLATION INFORMATION

Audio Warning Heat Switch on V-8 Engines with Standard Cooling

1. Drain cooling System.
2. Disconnect port hoses from thermostat housing.
3. Remove Tan/Blue wire from water heat switch in port side of thermostat housing. Remove switch.



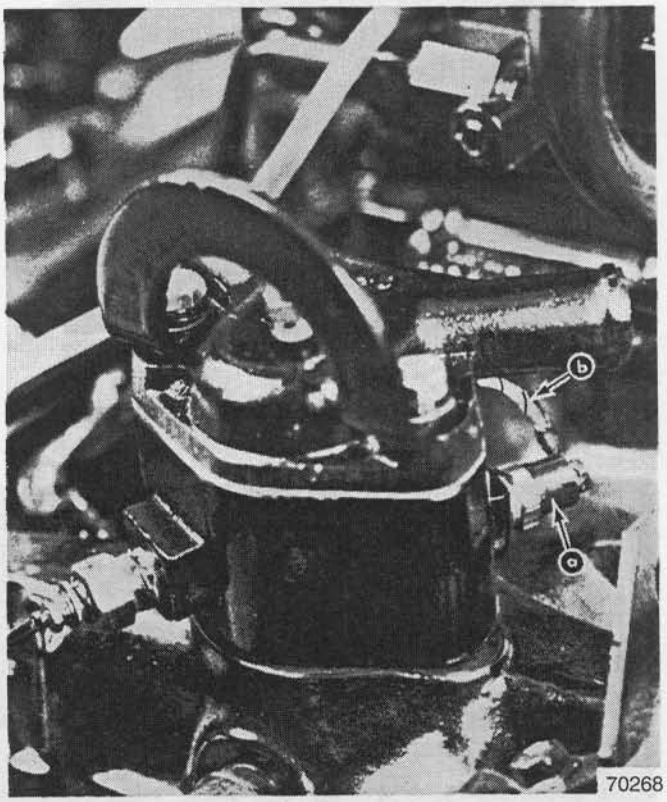
23462

a - Audio Warning Heat Switch
b - Tan/Blue Wire

4. Install audio warning heat switch as follows:
   a. Install heat switch into aft side of thermostat housing, using Loctite Pipe Sealant with teflon (DO NOT use teflon tape) to seal threads. Tighten securely.
   b. Attach Tan/Blue wire to heat switch with nut and lockwasher. Tighten nut securely.
   c. Coat connections with Liquid Neoprene.
5. Reconnect water hoses.

Audio Warning Heat Switch on V-8 Engines with Closed Cooling

1. Drain cooling system.
2. Remove Tan/blue wire from audio warning heat switch in rear hole of thermostat housing. Remove switch.



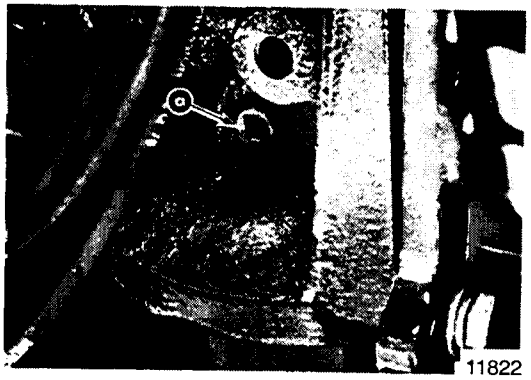
70268

a - Audio Warning Heat Switch
b - Tan/Blue Wire

3. Install audio warning heat switch as follows:
   a. Install heat switch into thermostat housing, using Loctite Pipe Sealant with teflon (DO NOT use teflon tape) to seal threads. Tighten securely.
   b. Attach Tan/Blue wire to heat switch with nut and lockwasher. Tighten securely.
   c. Coat connections with Liquid Neoprene.
4. Fill closed cooling system with proper water/anti-freeze solution. (Refer to COOLING SYSTEM - Closed Cooled Models, "Filling Closed Cooling Section".)

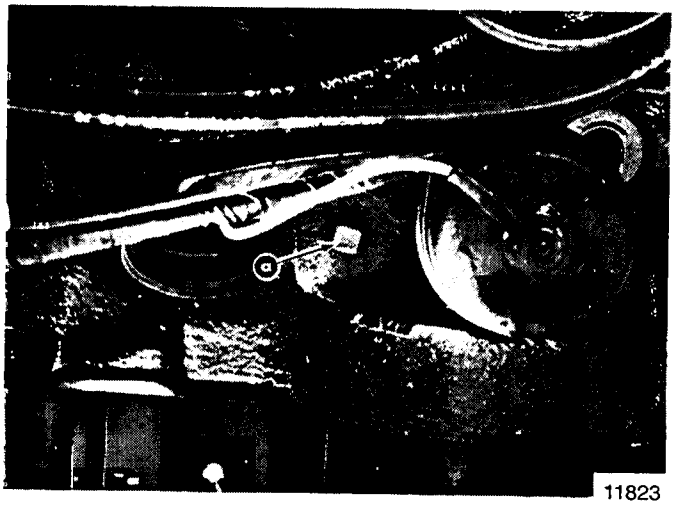
Audio Warning Oil Pressure Switch

1. Audio warning oil pressure switch (with reducer on small block V-8) is installed in place of engine block plug at one of the following locations depending on engine model:



a - Oil Plug

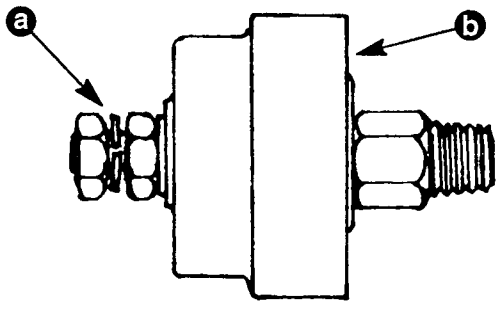
Oil Plug Location on Small Block V-8 Engines



a - Oil Plug

Oil Plug Location on Big Block V-8 Engines

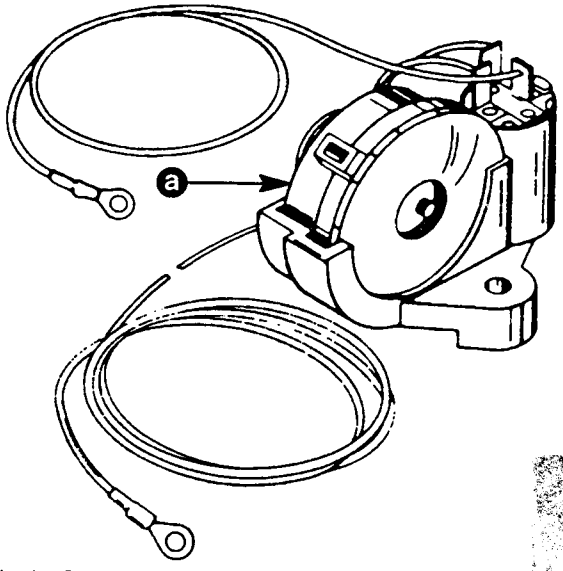
2. Disconnect Tan/Blue wire (from audio warning heat switch) at audio warning oil pressure switch.



a - Tan/Blue Wire Location (Wire Not Shown)
b - Audio Warning Oil Pressure Switch

3. Remove audio warning oil pressure switch.
4. Install switch as follows:
   a. Install switch using Loctite Pipe Sealant with teflon (DO NOT use teflon tape) to seal threads. Tighten securely.
   b. Connect Tan/Blue wire from audio warning heat switch to audio warning oil pressure switch with lockwasher and nut. Torque nut to 15 lb. in. (1.7 N·m).
   c. Coat connections with Liquid Neoprene.

Audio Warning Buzzer



a - Warning Buzzer

⚠ WARNING

Buzzer is not external ignition-proof, therefore, DO NOT mount buzzer in engine or fuel tank compartments.

1. Disconnect battery leads, if not already disconnected.
2. Mount buzzer under dashboard with 2 screws (from kit) in location that is not in obvious sight but is easily accessible for installation and maintenance. Location should not restrict buzzer sound and also should be within limits of 18 in. (460 mm) purple lead. (Lead will be connected to instrument terminal in dashboard.)
3. Attach purple lead to "+12V" switched terminal of any adjacent gauge [purple to purple (BIA) or purple to white (earlier MerCruiser)]. The attaching terminal should be "off" when ignition switch is in "Off" position.

IMPORTANT: 1988 model year engines require tan/blue lead (from kit) to be routed from buzzer to engine compartment and attached as indicated following.

1989 and newer model year engines have tan/blue wire in wiring harness. (Discard tan/blue wire from kit). Make connections as indicated following.

4. Plug male terminal of tan/blue wire (on buzzer) to female terminal of tan/blue wire (supplied in kit), or to existing tan/blue wire on harness. If required route tan/blue wire to engine compartment supporting wire every 18 in. (46 cm). Be sure that wire does not chafe or get pinched and does not come in contact with bilge water or moving parts.
5. Connect tan/light blue lead from buzzer to engine water heat switch or oil pressure switch, whichever is more accessible with lockwasher and nut. Torque nut to 15 lb. in. (1.7 N·m). (DO NOT over-tighten.)
6. Place decal (Figure 1) on bottom of glass face of water temperature gauge and of oil pressure gauge, or equipped.

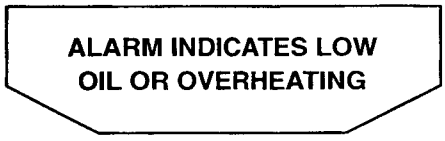


Figure 1. Decal (To be Placed on Face of Gauge)

7. Place decal (Figure 2) in convenient location on dashboard.

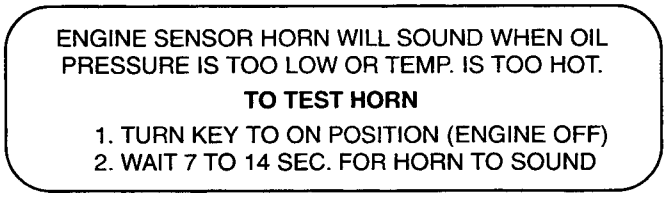


Figure 2. Decal (To be Placed on Dashboard)

8. Reconnect battery leads.
9. Fill Closed Cooling System (on engines so equipped) with water/anti-freeze solution.
10. Test switch (horn) as explained on decal. (Figure 1)
11. Seal all electrical connections with liquid neoprene.

Operation

It is recommended that the system be tested (per the instructions on the dashboard decal, (Figure 2) at least once every five (5) hours of operation.

During boat operation if the horn sounds, look for one or more of the following operation problems:

Problem	Remedy
Low Engine Oil (Check Oil Pressure Gauge or Dipstick)	Add Oil per Instructions in Owner's Manual
Cooling Water Pickup is Blocked or Clogged (Check Water Temperature Gauge.)	Clear the Water Pickup of Foreign Material.

NOTE: The horn will sound, if, while docking or otherwise maneuvering slowly, the engine stalls and is not restarted, and the ignition key is left "on" (similar to test procedure).

Maintenance

Maintenance inspection is the owner's responsibility and must be performed at intervals specified, following:

Normal Service - Every 50 hrs. of operation or 60 days (whichever comes first)
Severe Service - Every 25 hrs. of operation or 30 days (whichever comes first)

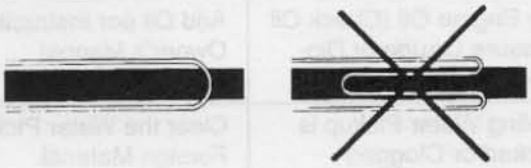
NOTE: Operation in salt water is considered "Severe Service".

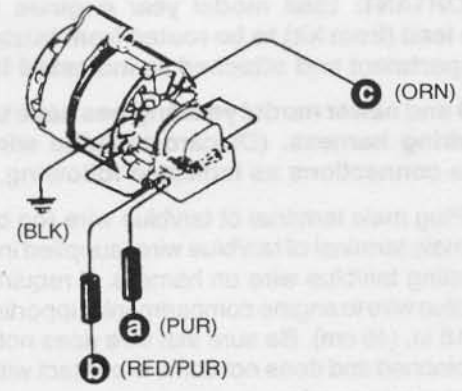
1. Check buzzer mounting screws, heat switch and oil pressure switch for adequate tightness. Tighten, if loose, but DO NOT over-tighten.
2. Check all wiring connections to be sure that they are tight and sealed where necessary.

Resistance Wire Replacement Kit 84-94227A2

Installation Information

IMPORTANT: Do not tape more than two (2) layers of resistance wire in any one section of engine harness.



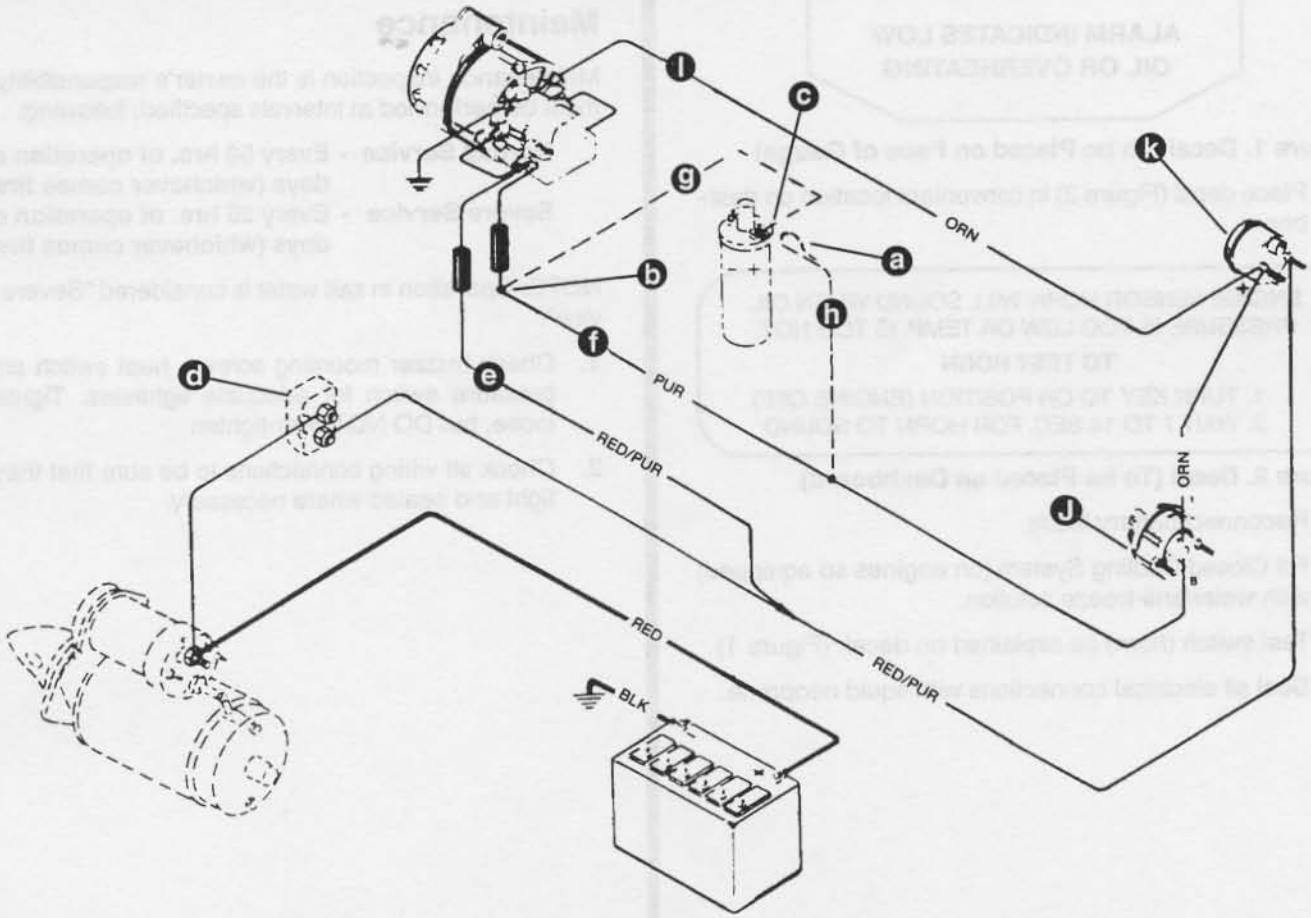


a - Excitation Lead
b - Sensing Lead
c - Output Lead

3-Wire Motorola or Mando Alternators

NOTE: Refer to "Wiring Diagram", following.

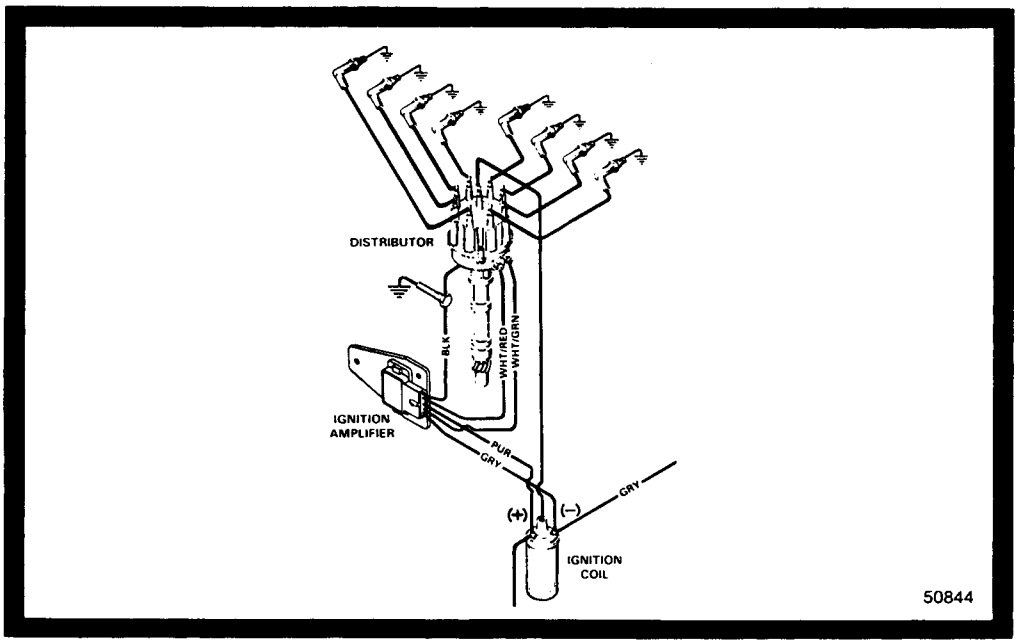
Wiring Diagram - Resistance Wire Replacement



a - Disconnect Damaged White or Purple (Stainless Steel Core) Resistance Wire from Ignition Coil and Tape Back to Harness
b - Strip Outer Insulating Jacket of White or Purple (Copper Core) Wire. Wrap and Solder Copper End of NEW Resistance Wire to White or Purple Wire Insulate Junction
c - Attach Ring Terminal End of NEW Resistance Wire to Ignition Coil and Coat Connection with Quicksilver Liquid Neoprene
d - Circuit Breaker
e - Sensing Lead
f - Excitation Lead
g - New Resistance Wire
h - Old Resistance Wire
j - Ignition Switch
k - Ammeter
l - Output Lead

3-Wire Alternator System with or without Electric Choke (Typical)

ELECTRICAL SYSTEM



4

F

WIRING DIAGRAMS

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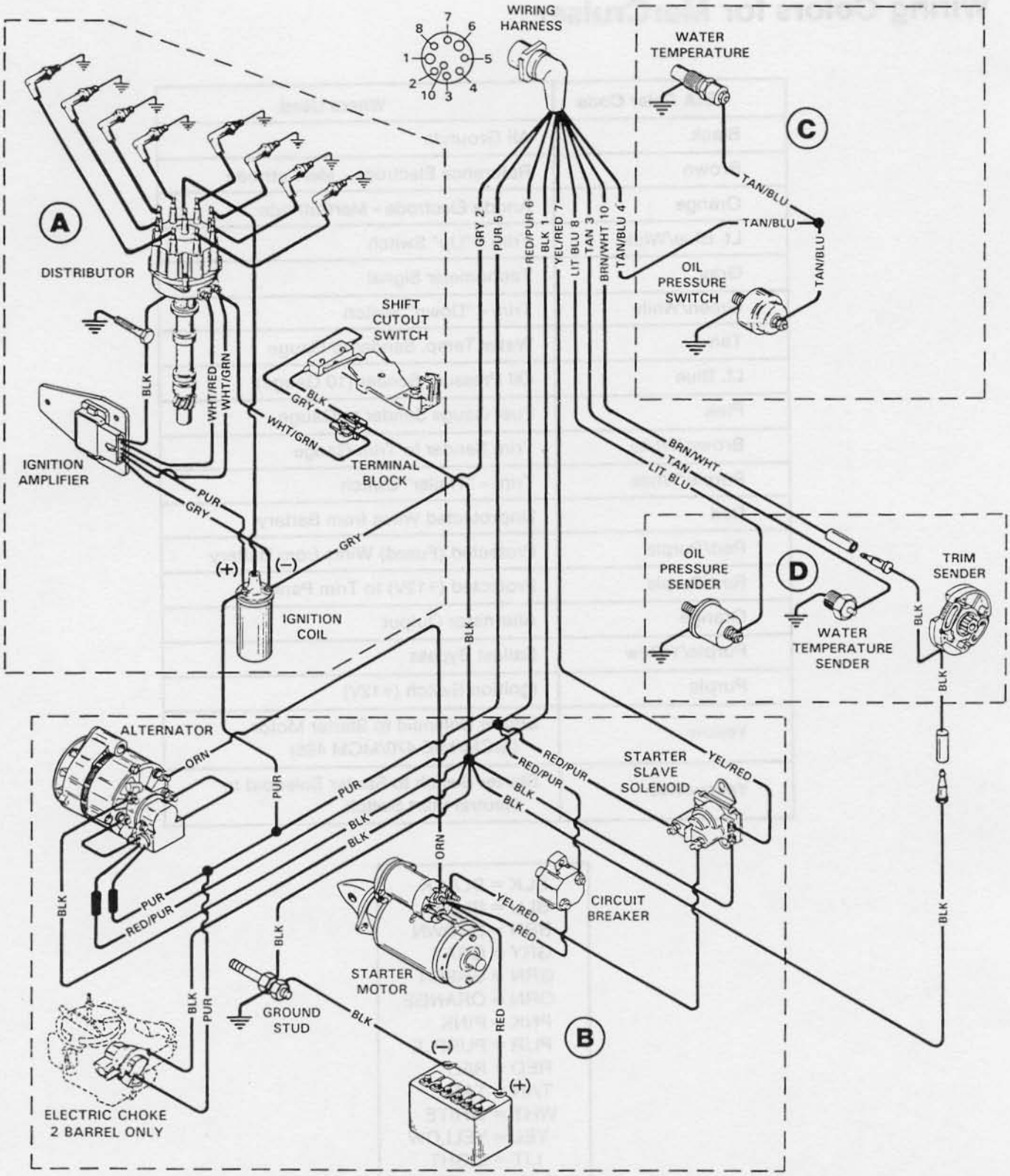
Wiring Colors for MerCruiser

BIA Color Code	Where Used
Black	All Grounds
Brown	Reference Electrode - MerCathode
Orange	Anode Electrode - MerCathode
Lt. Blue/White	Trim - "Up" Switch
Gray	Tachometer Signal
Green/White	Trim - "Down" Switch
Tan	Water Temp. Sender to Gauge
Lt. Blue	Oil Pressure Sender (10 Gauge)
Pink	Fuel Gauge Sender to Gauge
Brown/White	Trim Sender to Trim Gauge
Purple/White	Trim - "Trailer" Switch
Red	Unprotected Wires from Battery
Red/Purple	Protected (Fused) Wires from Battery
Red/Purple	Protected (+12V) to Trim Panel
Orange	Alternator Output
Purple/Yellow	Ballast Bypass
Purple	Ignition Switch (+12V)
Yellow	Starter Solenoid to Starter Motor (MCM/MIE 470/MCM 485)
Yellow/Red	Starter Switch to Starter Solenoid to Neutral Start Switch

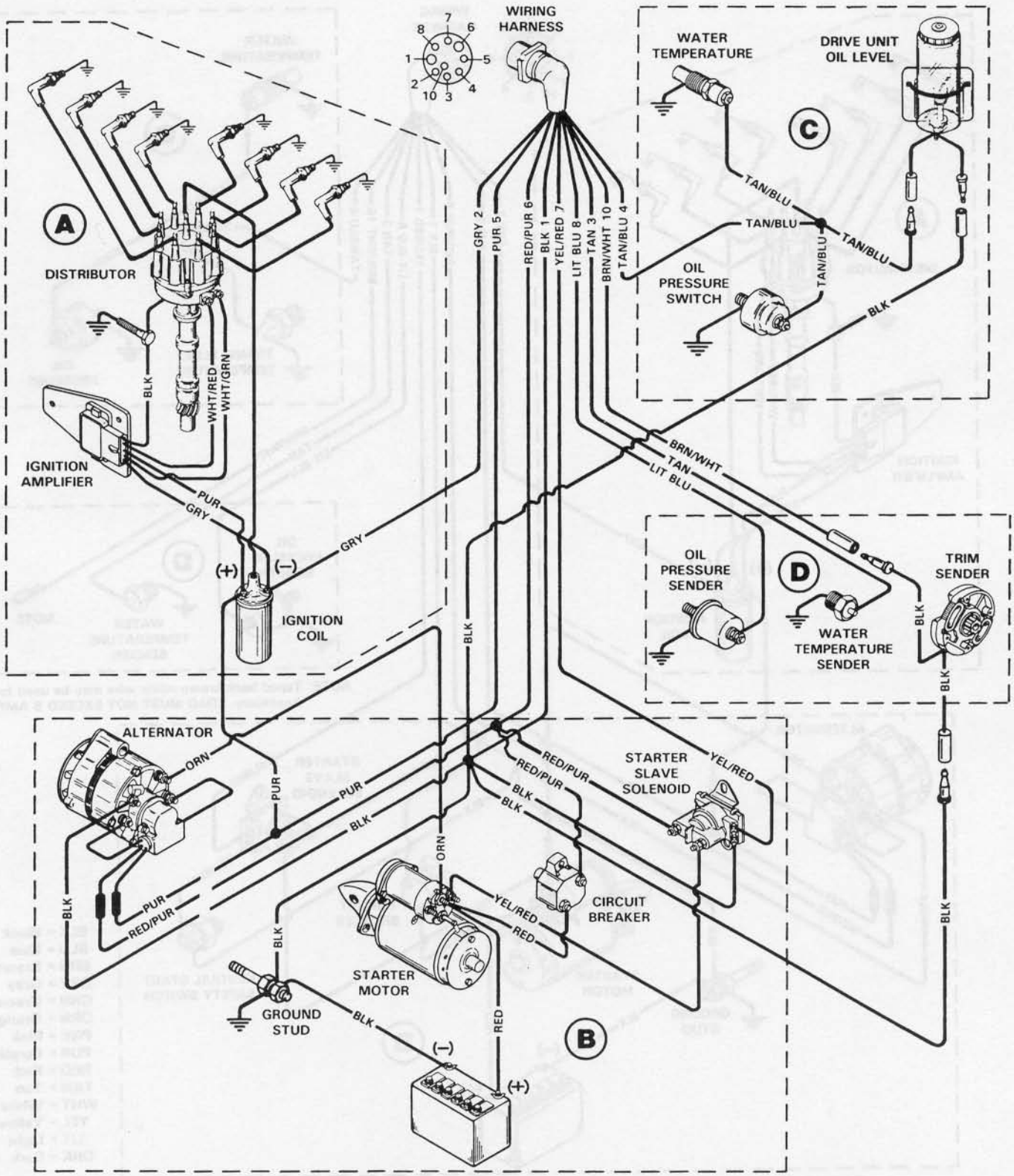
BLK = BLACK
BLU = BLUE
BRN = BROWN
GRY = GRAY
GRN = GREEN
ORN = ORANGE
PNK = PINK
PUR = PURPLE
RED = RED
TAN = TAN
WHT = WHITE
YEL = YELLOW
LIT = LIGHT
DRK = DARK



A: Ignition and Choke System
B: Starting and Charging System
C: Audio Warning System
D: Instrumentation System

50843

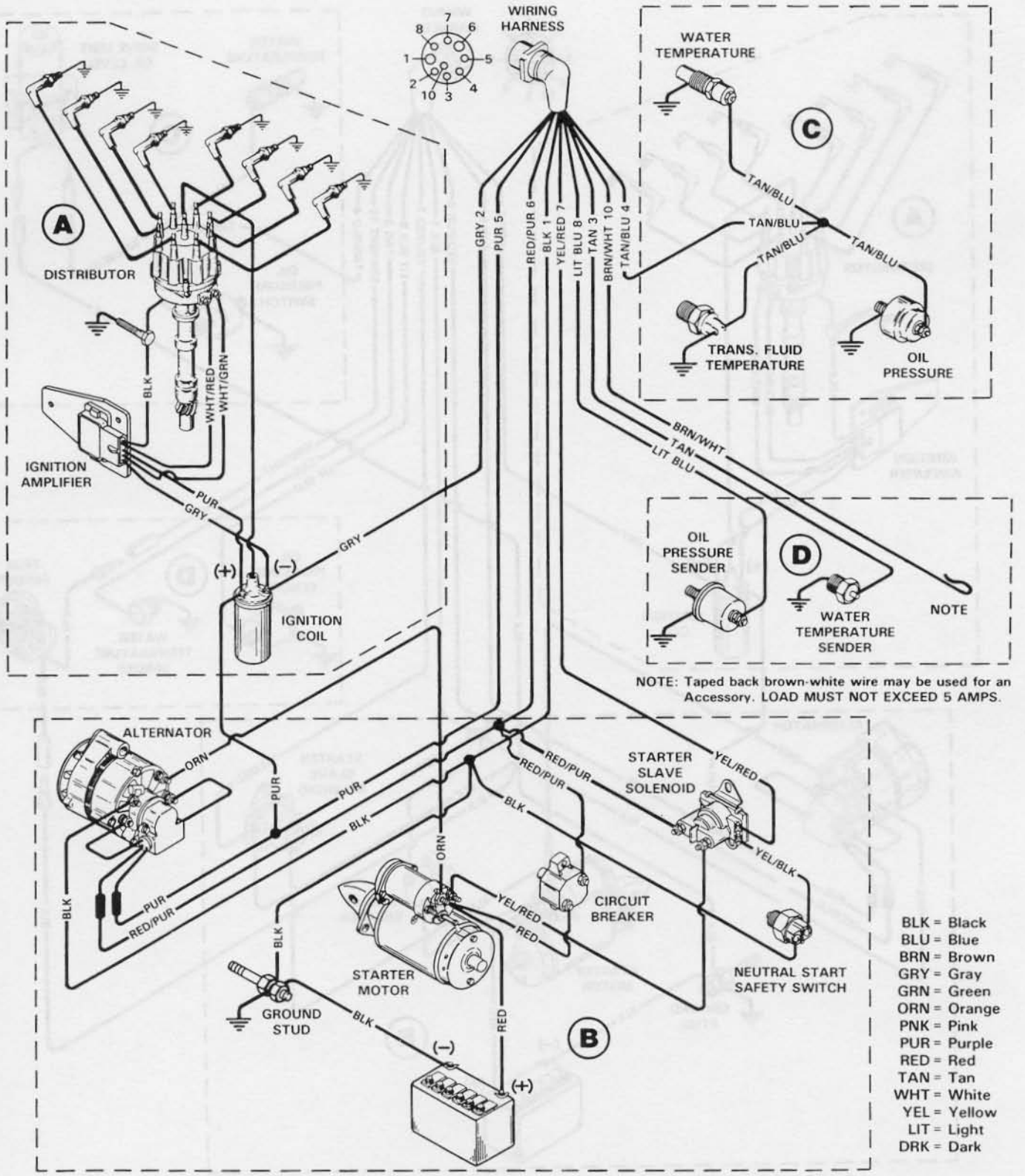
Alpha Drive — All Engines



A: Ignition and Choke System
B: Starting and Charging System
C: Audio Warning System
D: Instrumentation System

50844

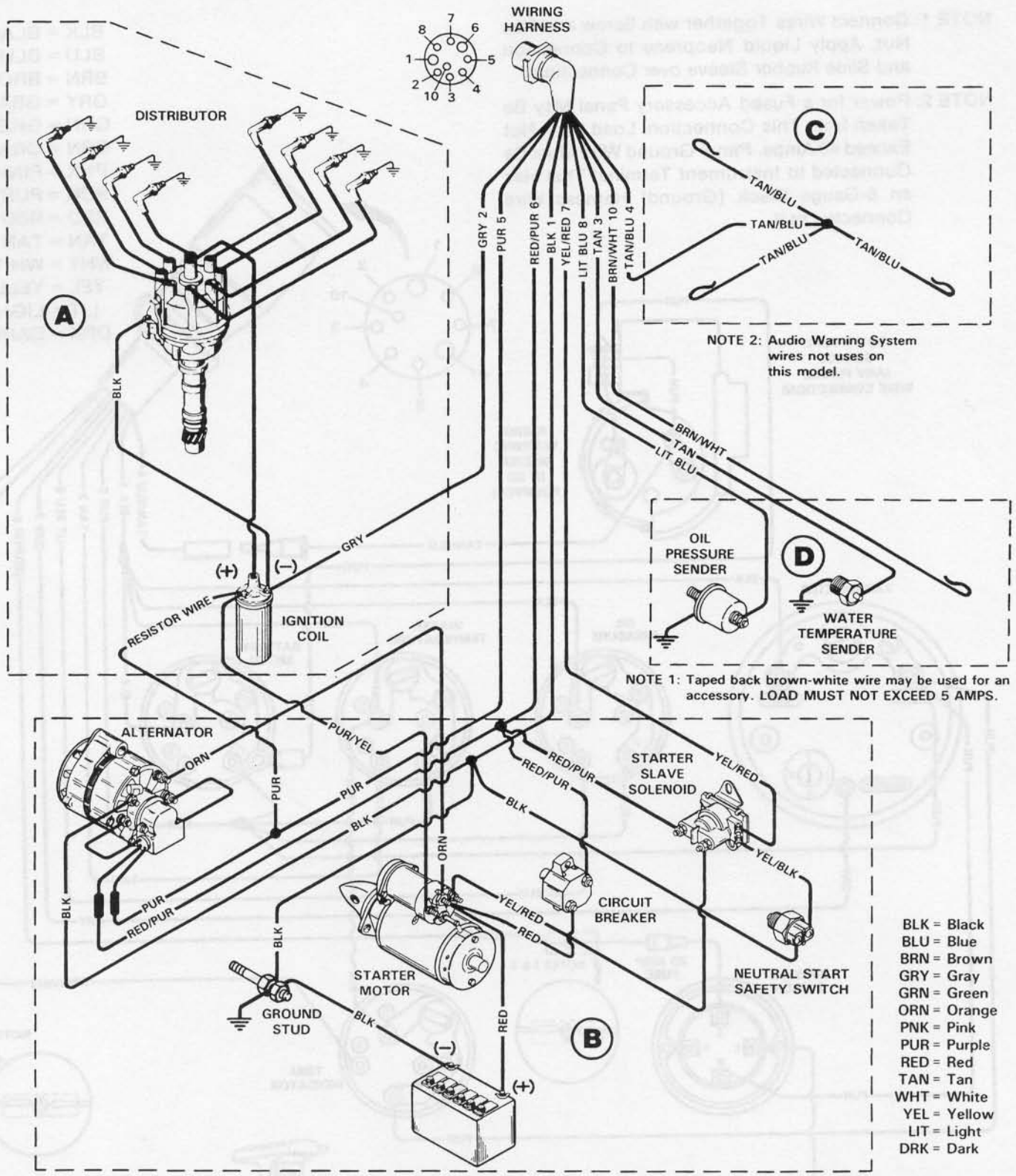
Bravo Drive — All Engines



A: Ignition System
B: Starting and Charging System
C: Audio Warning System
D: Instrumentation System

50773

MIE — All Bluewater Inboards and 350 Magnum Tournament Ski



A: Ignition System
B: Starting and Charging System
C: Audio Warning System (NOTE 2)
D: Instrumentation System (NOTE 1)

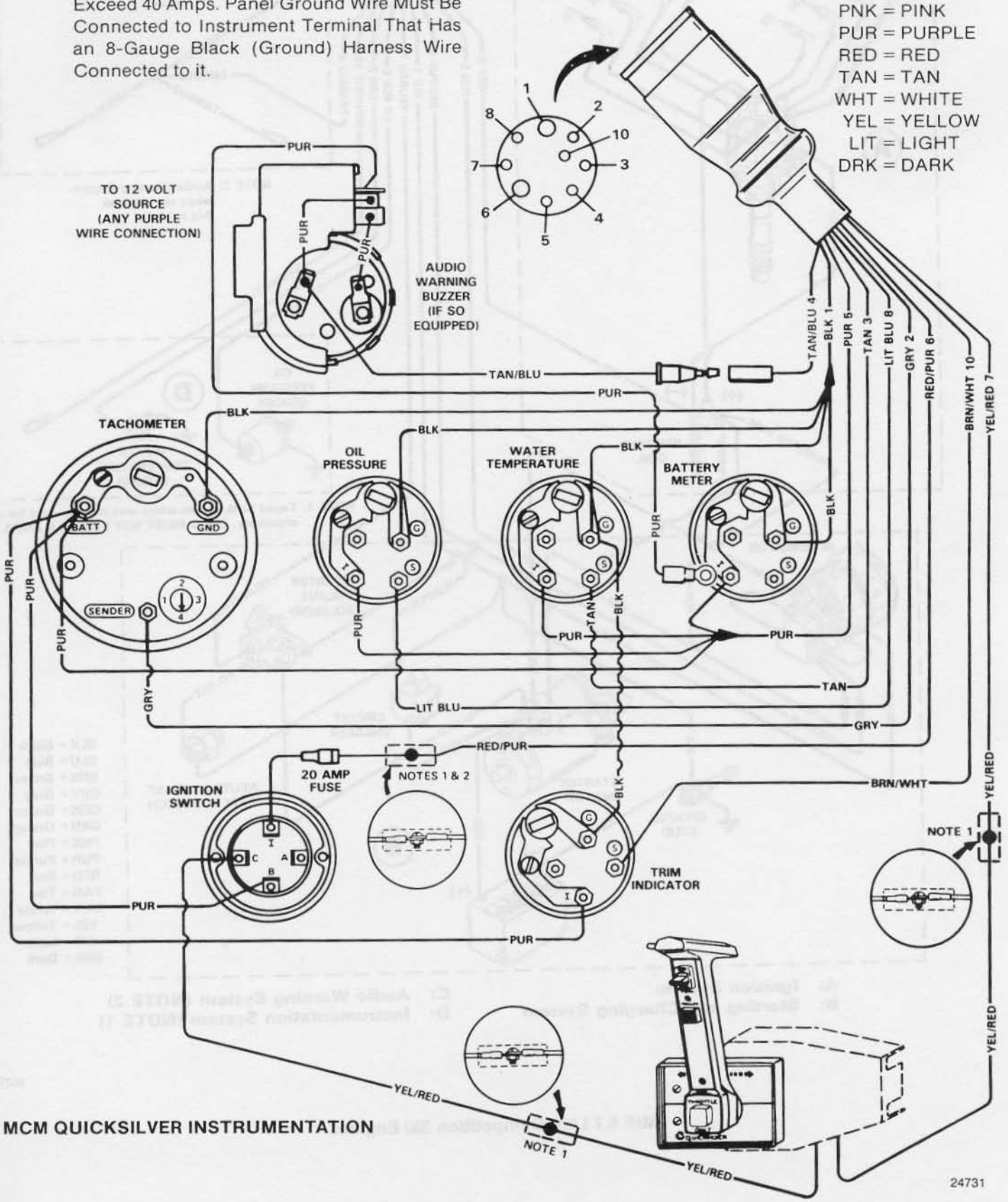
50774

MIE 5.7 Litre Competition Ski Engines

NOTE 1: Connect Wires Together with Screw and Hex Nut; Apply Liquid Neoprene to Connection and Slide Rubber Sleeve over Connection.

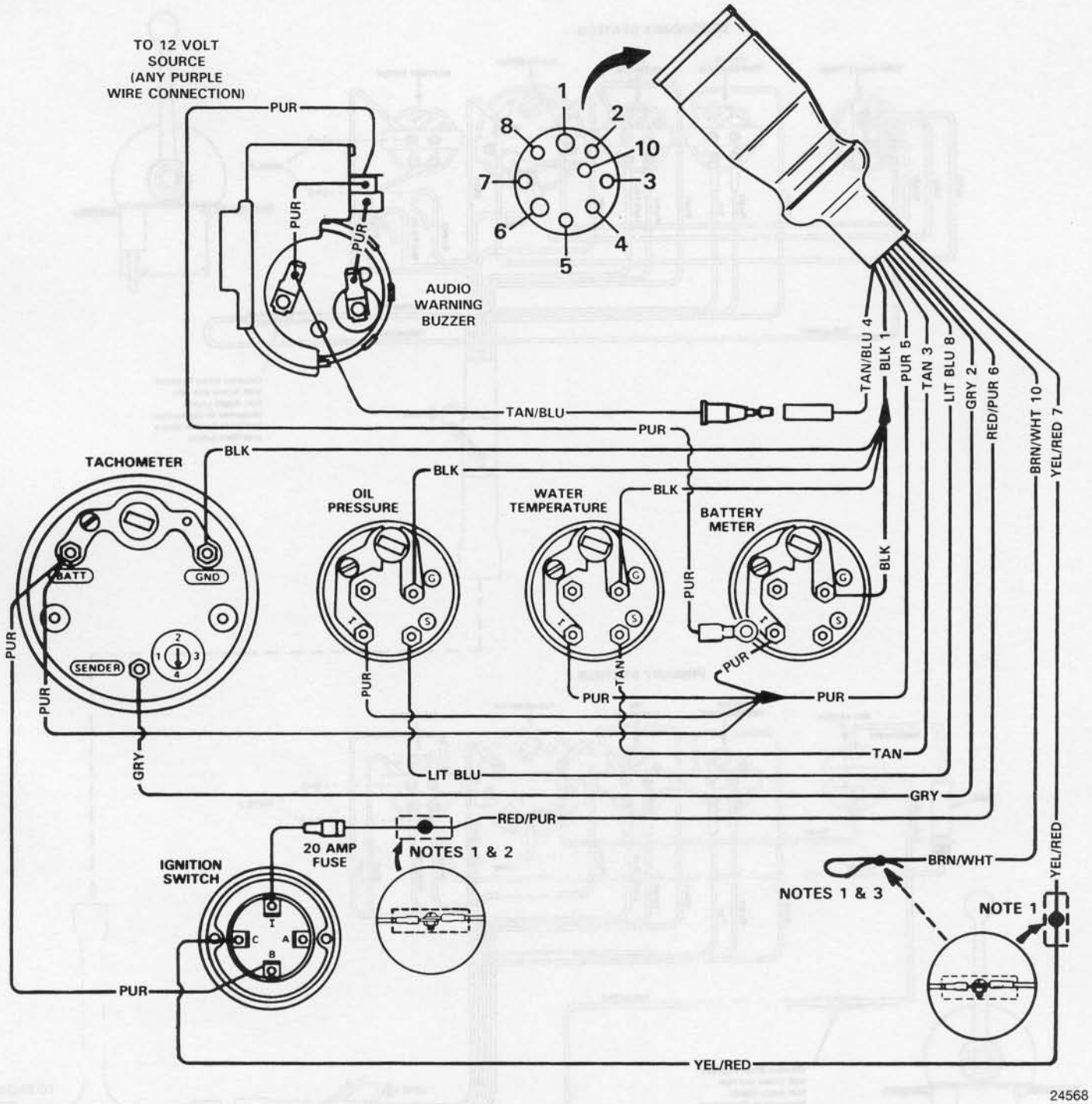
NOTE 2: Power for a Fused Accessory Panel May Be Taken from This Connection. Load Must Not Exceed 40 Amps. Panel Ground Wire Must Be Connected to Instrument Terminal That Has an 8-Gauge Black (Ground) Harness Wire Connected to it.

BLK = BLACK
BLU = BLUE
BRN = BROWN
GRY = GRAY
GRN = GREEN
ORN = ORANGE
PNK = PINK
PUR = PURPLE
RED = RED
TAN = TAN
WHT = WHITE
YEL = YELLOW
LIT = LIGHT
DRK = DARK

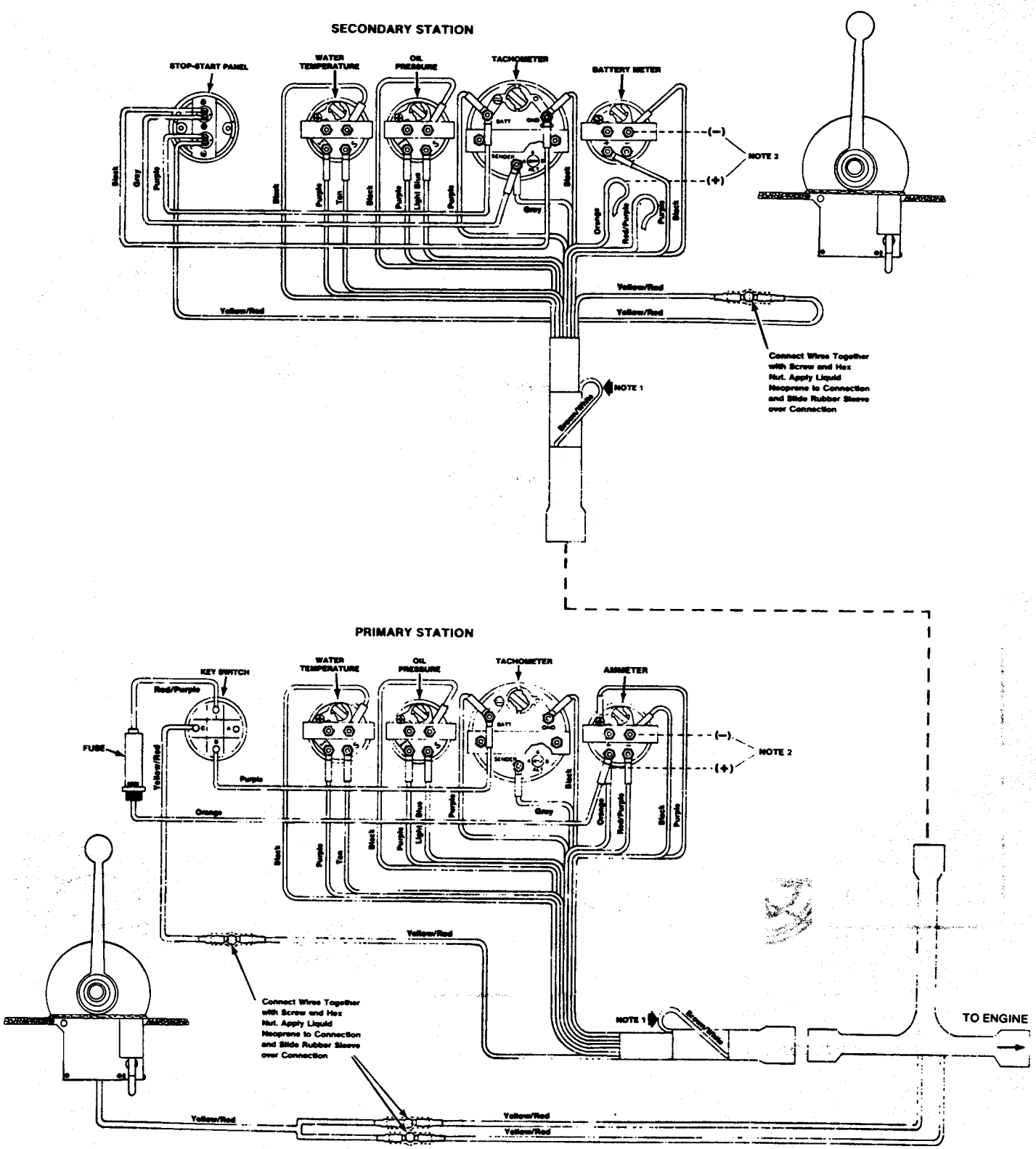


MCM QUICKSILVER INSTRUMENTATION

24731



MIE QUICKSILVER INSTSRUMENTATION



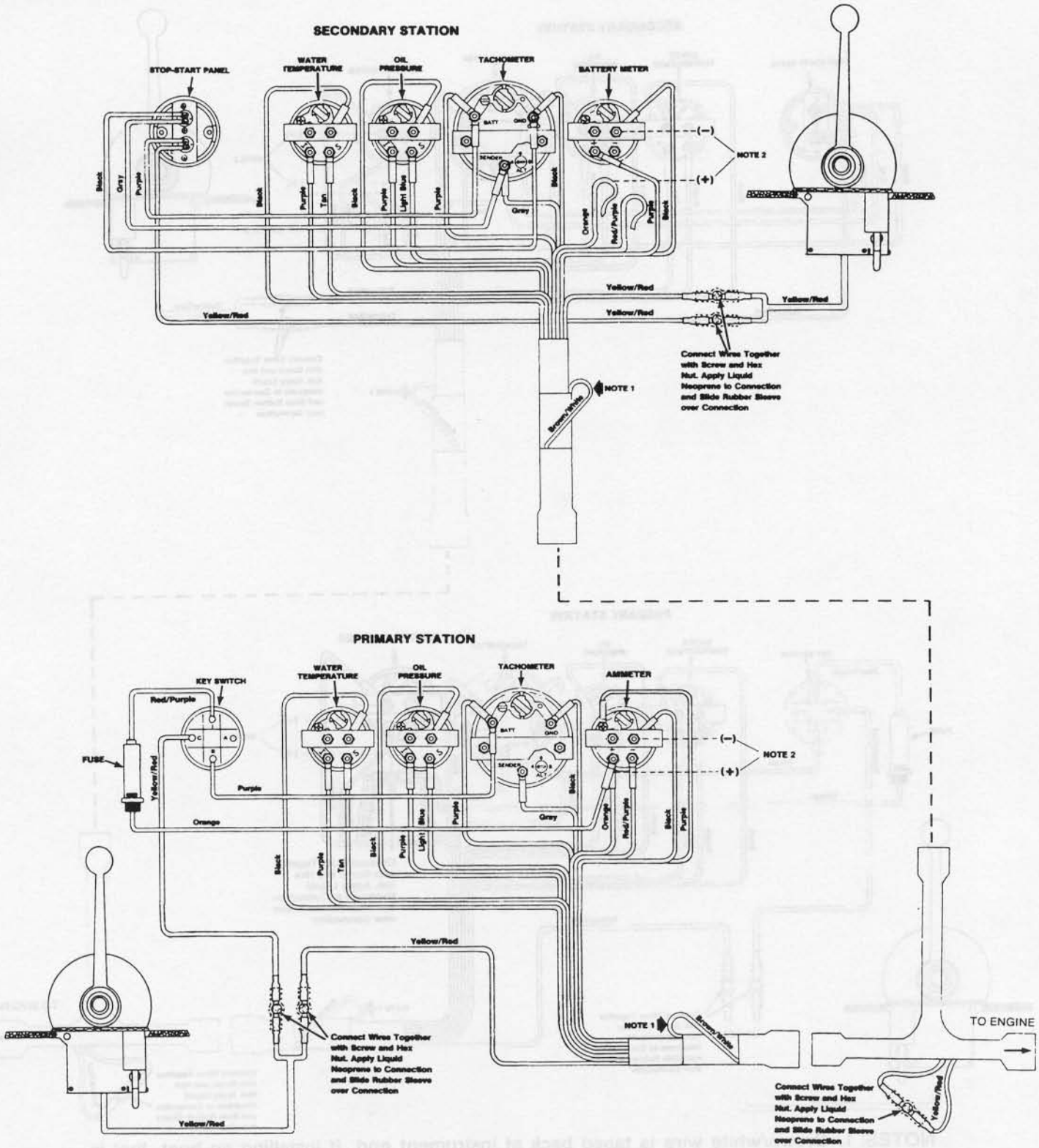
NOTE 1: Connect Wires Together with Screw and Hex Nut; Apply Liquid Neoprene to Connection and Slide Rubber Sleeve over Connection.

NOTE 2: Power for a Fused Accessory Panel May Be Taken from This Connection. Load Must Not Exceed 40 Amps. Panel Ground Wire Must Be Connected to Instrument Terminal That Has an 8-Gauge Black (Ground) Harness Wire Connected to it.

NOTE 3: Taped back brown-white wire may be used for an accessory. LOAD MUST NOT EXCEED 5 AMPS.

DUAL STATION WIRING

Using a Neutral Safety Switch in Only One Remote Control

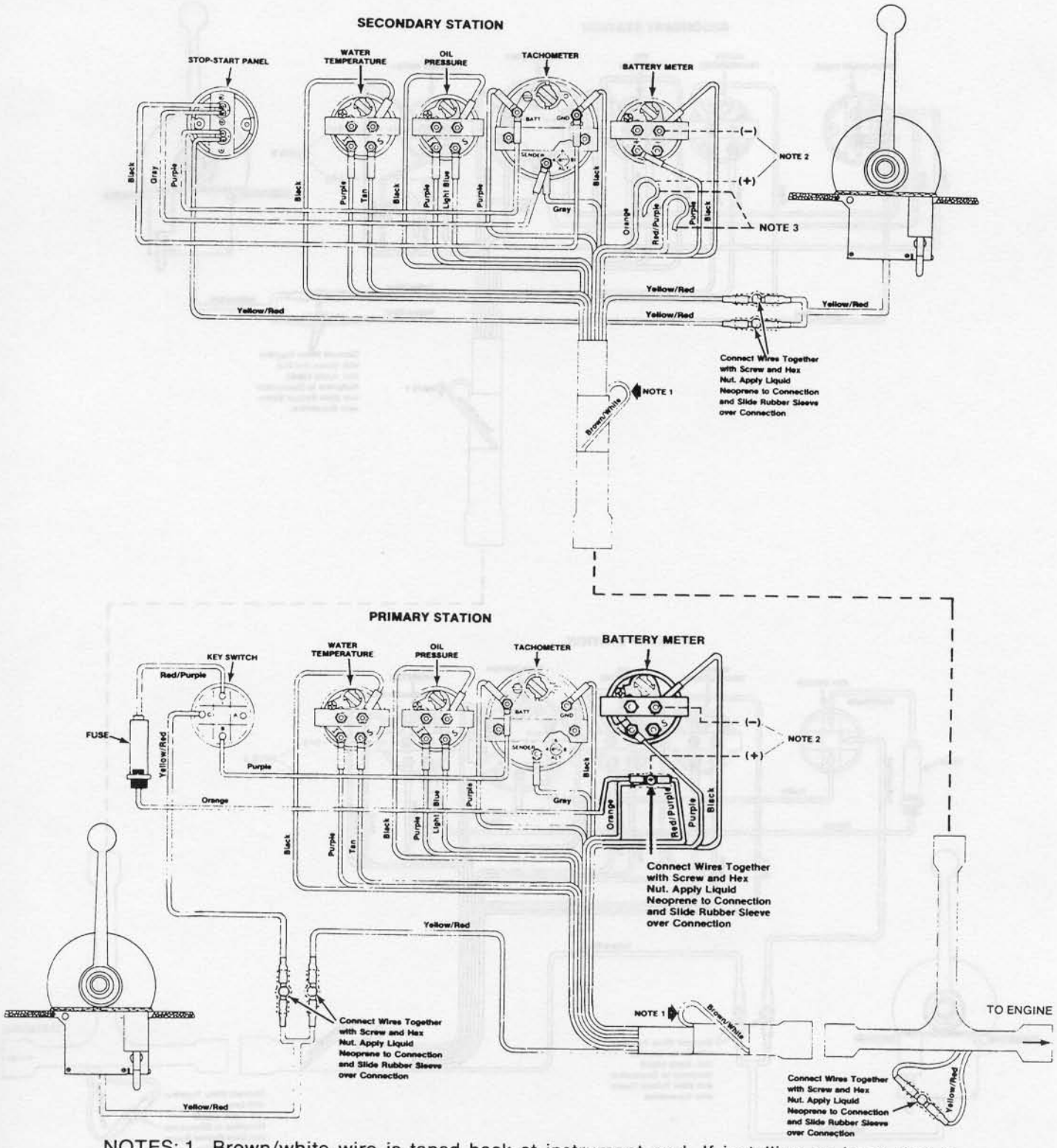


NOTES: 1. Brown/white wire is taped back at instrument end. If installing on boat, that is equipped with MerCruiser Stern Drive, brown/white wire is connected to trim sender terminal block. If installing on MerCruiser Inboard, brown/white wire is taped back at engine end, or it may be used for an accessory (limit 5 amps).

2. An accessory fuse panel may be connected at this location. The combined current draw of the primary station and secondary station MUST NOT exceed 35 amps.

DUAL STATION WIRING

Using a Neutral Safety Switch in Both Remote Controls

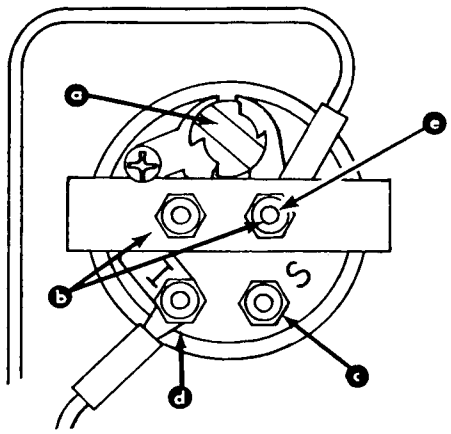


NOTES: 1. Brown/white wire is taped back at instrument end. If installing on boat, that is equipped with MerCruiser Stern Drive, brown/white wire is connected to trim sender terminal block. If installing on MerCruiser Inboard, brown/white wire is taped back at engine end, or it may be used for an accessory (limit 5 amps).

2. An accessory fuse panel may be connected at this location. The combined current draw of the primary station and secondary station MUST NOT exceed 35 amps.
3. Tape back and insulate with at least 4 layers of electrical tape.

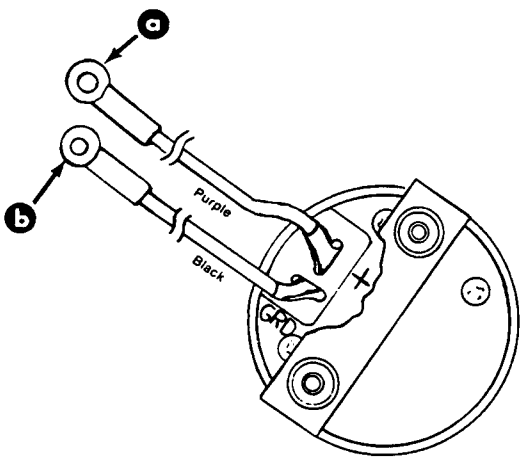
DUAL STATION WIRING
Neutral Safety Switch in Engine Wiring Harness

Battery Meter Gauge



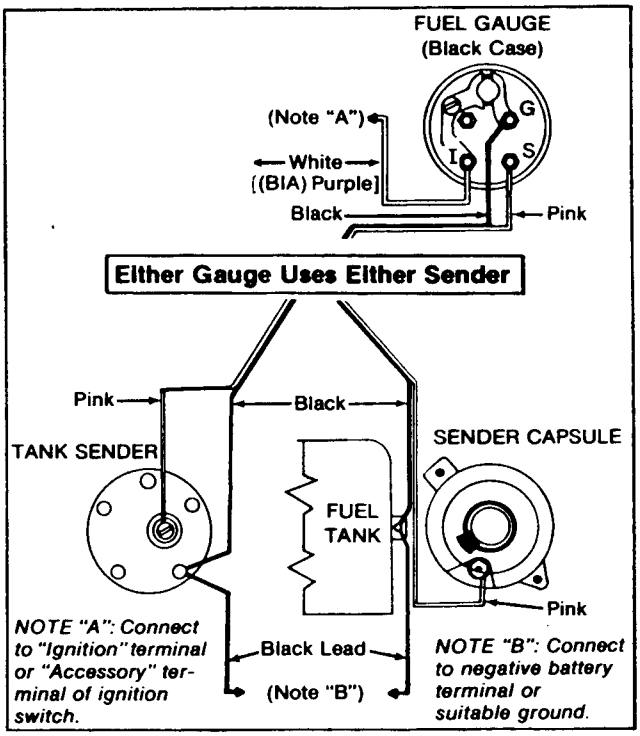
a - Lamp Mounting Hole
b - Gauge Mounting Studs
c - Terminal Not Used
d - Purple (or White) Jumper Wire from This Terminal to I (or +) Terminal on Water Temperature or Oil Pressure Gauge
e - Black Jumper Wire from This Terminal to Ground Terminal on Water Temperature or Oil Pressure Gauge

Cruiselog



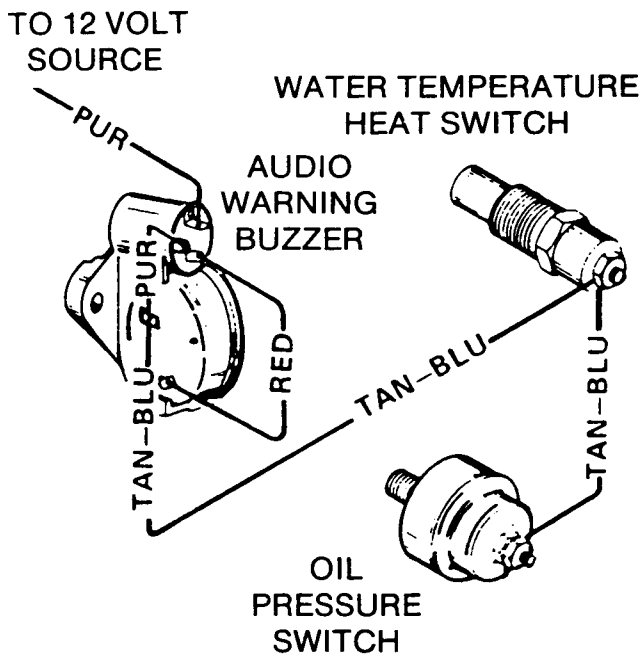
a - Connect to Ignition Switch Activated 12-Volt Positive (+) Source
b - Connect to Negative (-) Ground

Fuel Gauge and Sender

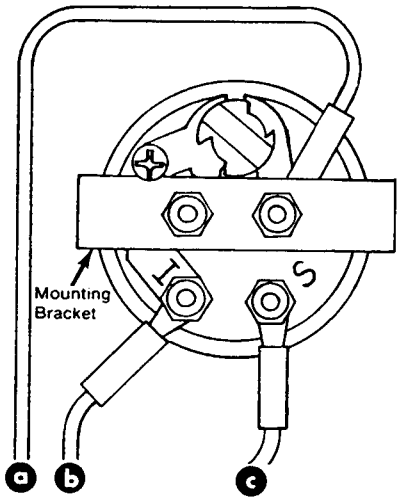


Audio Warning System

⚠WARNING
Buzzer is not external ignition-proof, therefore, DO NOT mount buzzer in engine or fuel tank compartments.

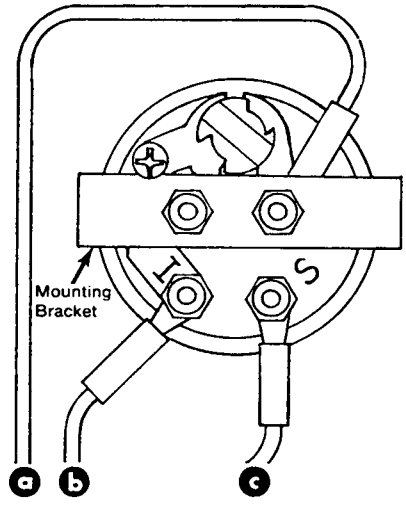


Water Temperature Gauge



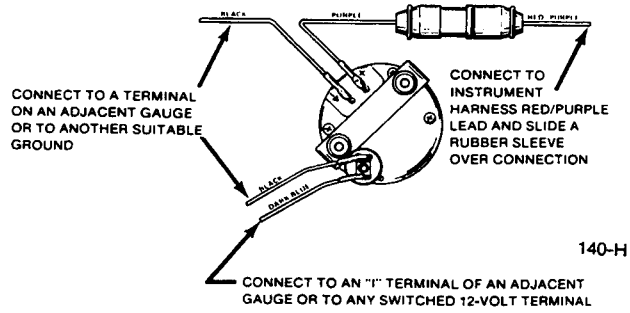
Pre BIA Color Code	BIA Color Code	Leads to —
(a) Black Wire	(a) Black	(a) Ground
(b) White Wire	(b) Purple	(b) Switched 12-Volt Terminal
(c) Green Wire	(c) Tan	(c) Sender Lead

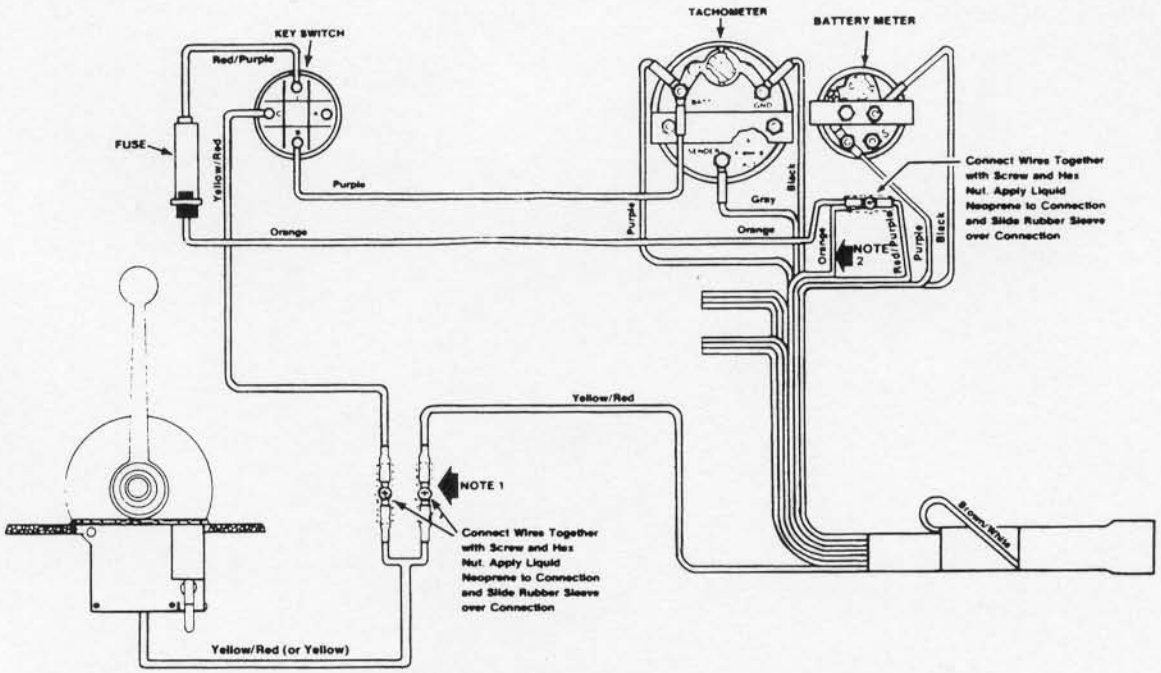
Oil Pressure Gauge



Earlier Model MerCruiser Color Code	BIA Color Code	Leads to —
(a) Black Wire	(a) Black	(a) Ground
(b) White Wire	(b) Purple	(b) Switched 12-Volt Terminal
(c) Orange Wire	(c) Light Blue	(c) Sender Lead

Clock





KEY SWITCH INSTALLATION WHEN USING BIA COLOR-CODED WIRING HARNESS

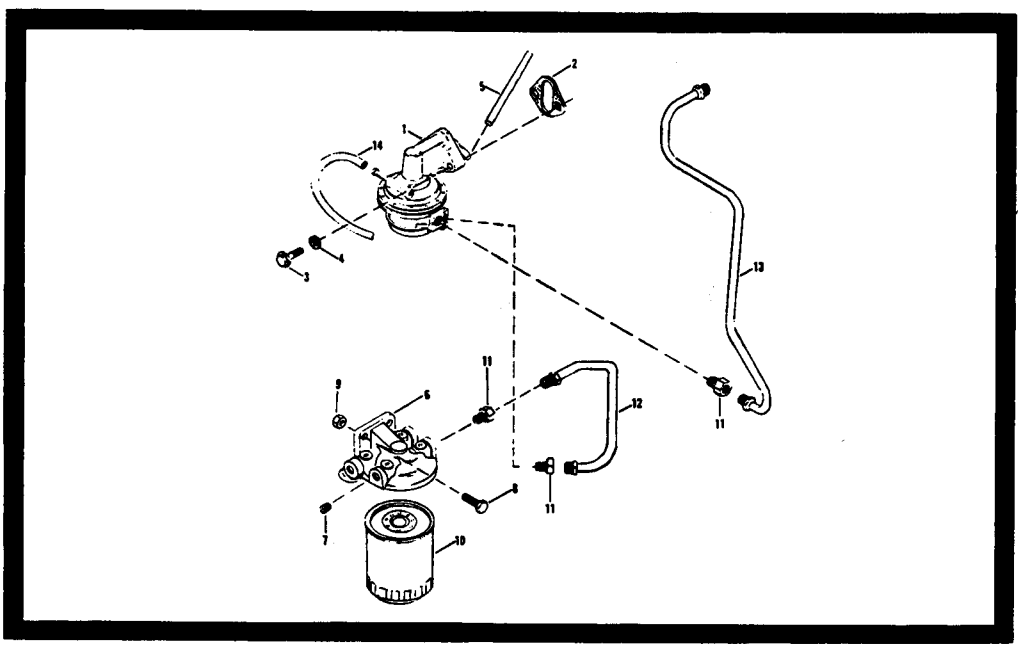
140-H

⚠CAUTION

Neutral start safety switch MUST BE USED in cranking circuit. If remote control does not incorporate this switch, it must be part of engine wiring.

NOTE 1: If engine is equipped with a neutral safety switch (on the engine or transmission), connect yellow/red ignition switch wire directly to yellow/red wiring harness wire with screw, nut and sleeve. A neutral safety switch MUST BE used in starting circuit to prevent accidental starting of engine when in gear.

FUEL SYSTEM



FUEL DELIVERY SYSTEM and FUEL PUMPS

5

A

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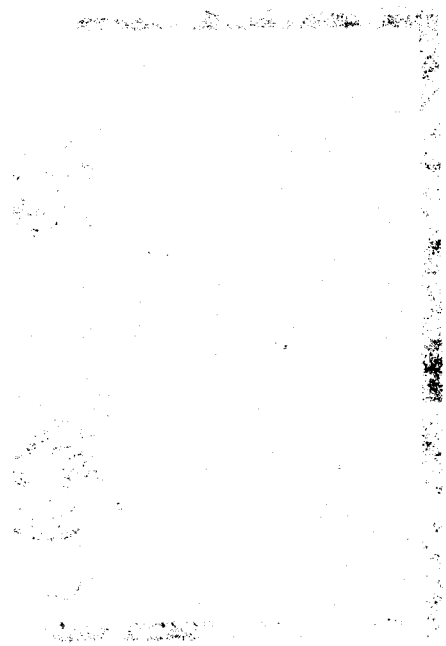
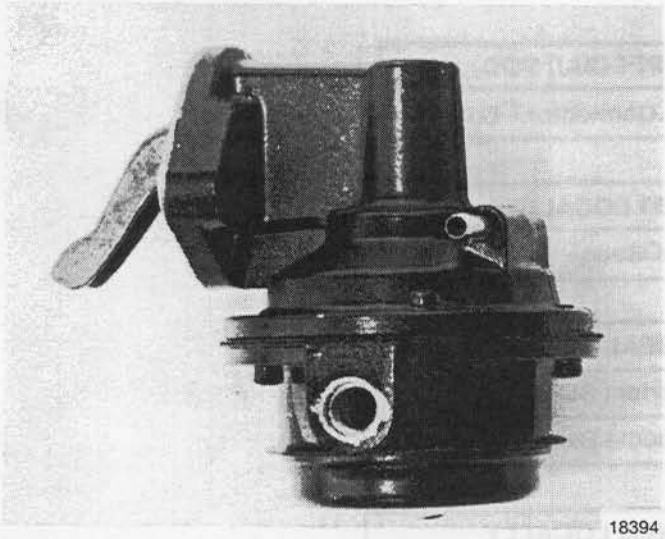
NOTICE

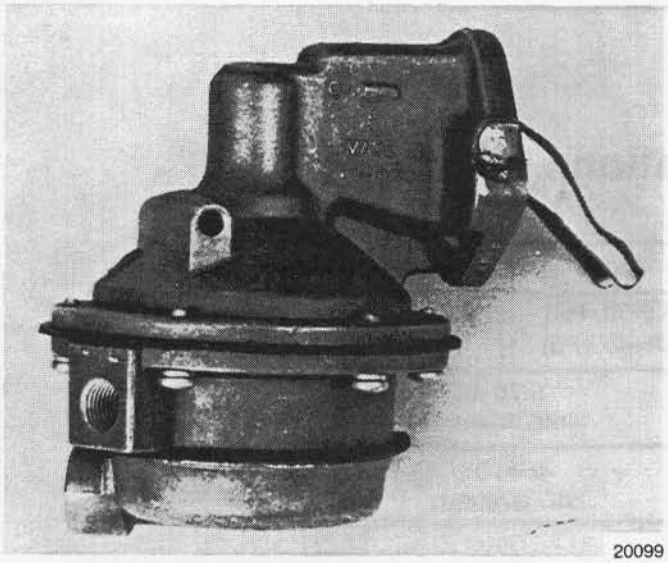
Refer to SECTION 6A - Seawater Cooled Models, "Belt Driven Seawater Pickup Pump with Combination Fuel Pump" for service information on the fuel pump drive for Generation V engines.



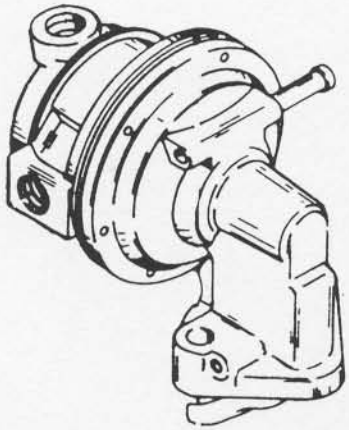
Identification



Airtex Pump



Carter Pump



Generation V Engine Pump
(Quicksilver Part Number 818383T)

Replacement Parts Warning

⚠WARNING

Electrical, ignition and fuel system components on your MerCruiser are designed and manufactured to comply with U.S. Coast Guard Rules and Regulations to minimize risks of fire and explosion.

Use of replacement electrical, ignition or fuel system components, which do not comply with these rules and regulations, could result in a fire or explosion hazard and should be avoided.

Torque Specifications

Fastener Location	Lb. Ft. (N·m)
Fuel Pump to Block	25 (34)
Fuel Lines	18 (24)
Fuel Fittings - See Caution Below	
Fuel Pump-to-Seawater Pump [1] Housing	25-28 (34-38)

[1] On Generation V Engine

⚠CAUTION

When installing brass fittings or plugs into a new fuel pump or fuel filter base, the following instructions must be used to prevent cracking the pump or filer base castings.

a. Apply #592 Loctite Pipe Sealant with Teflon to threads of fittings or plugs (DO NOT USE TEFLON TAPE).

b. Thread fittings or plugs into fuel pump or filter base until finger-tight.

c. Use a wrench to tighten fitting or plug an additional 1-3/4 to 2-1/4 turns. DO NOT OVER-TIGHTEN.

Tools/Lubricants/Sealants

MERCURY MARINE SPECIAL TOOL	
91-18078	Fuel Pressure Connector - Carb

TOOLS OBTAINED LOCALLY
Fuel Pressure Gauge

LUBRICANTS/SEALANTS	
92-34227	Quicksilver Perfect Seal
92-42649	Quicksilver Needle Bearing Lubricant

SEALANTS OBTAINED LOCALLY
#592 Loctite Pipe Sealant with Teflon

Specifications

Type of Fuel Pump	Airtex	Carter
Pump Pressure (1800 RPM)	5.5-7.0 PSI (38-48 kPa)	5.25-6.5 PSI (36-44 kPa)
Push Rod Length	5.76 in. (146.304mm)	
Push Rod Movement	3.44 in. (87.376mm)	

Precautions

⚠WARNING
ALWAYS disconnect battery cables from battery BEFORE working on fuel system to prevent fire or explosion.

⚠WARNING
Be careful when changing fuel system components; gasoline is extremely flammable and highly explosive under certain conditions. Be sure that ignition key is "OFF." DO NOT smoke or allow sources of spark or flame in the area while changing fuel filters. Wipe up any spilled fuel immediately.

⚠WARNING
Make sure that no fuel leaks exist, before closing engine hatch.

⚠CAUTION
DO NOT operate engine without cooling water being supplied to seawater pickup pump or pump impeller will be damaged, and subsequent overheating damage may result.

Fuel Delivery System

Recommendations

⚠WARNING
Boating industry standards (BIA, ABYC, etc.) federal standards and Coast Guard regulations MUST BE adhered to when installing fuel delivery system.

When designing and installing fuel delivery system, the following information MUST BE observed:

1. Fuel tank should be mounted below carburetor level, if possible. If tank is mounted above carburetor level, gravity feed may cause carburetor fuel inlet needle to unseat, and flooding may result.
2. Fuel pickup should be at least 1 in. (25mm) from the bottom fo the fuel tank to prevent picking up water or other impurities.
3. Fuel lines used MUST BE Coast Guard approved (USCG type A) and MUST NOT BE SMALLER THAN 3/8 in. (9.5mm) I.D. On installations where long lines or numerous fittings are required, larger size lines should be used.
4. Fuel line should be installed free of stress and firmly secured to prevent vibration and/or chafing.
5. Sharp bends in fuel line should be avoided.
6. A flexible fuel line must be used to connect fuel line to engine to absorb deflection when engine is running.

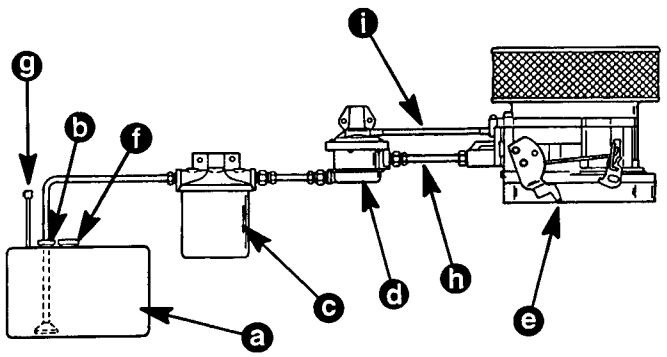
Description

The fuel system consists of a fuel tank(s), a water separating fuel filter (if so equipped), a fuel pump, and a carburetor.

The fuel is stored in the fuel tank. When the engine is cranking or running, fuel is drawn from the fuel tank, through the water separating filter (if so equipped), by a mechanically operated fuel pump. The fuel pump is operated by the engine camshaft, or by the seawater pump driveshaft (on Generation V Engines).

The fuel is pushed through the fuel line to the carburetor where it is metered and fed to the engine.

Fuel System Components (Typical)



50830

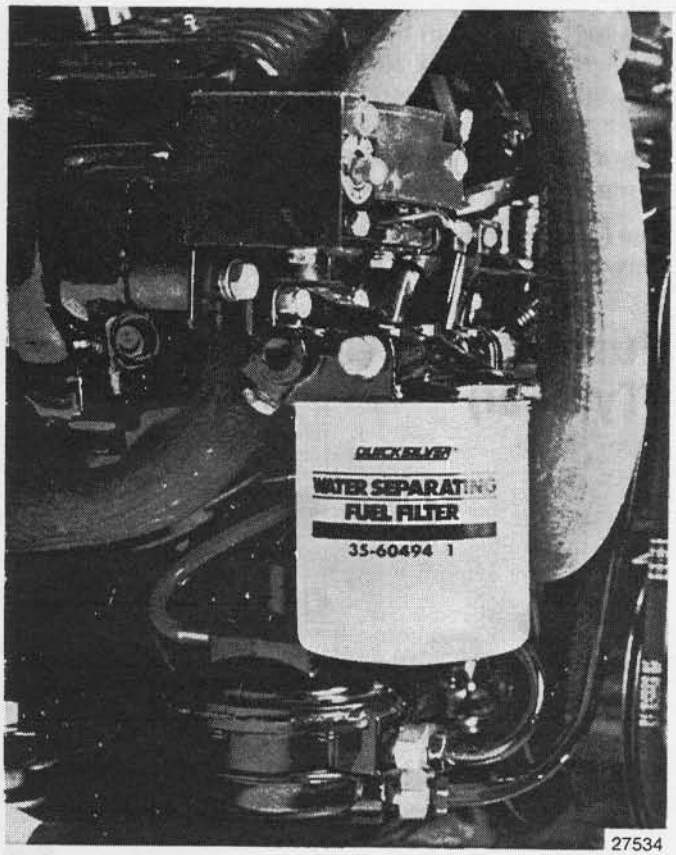
a - Fuel Tank
b - Anti-Siphon Valve
c - Water Separating Fuel Filter (Optional)
d - Fuel Pump
e - Carburetor
f - Fuel Filler
g - Vent Hose
h - Sight Tube

Water Separating Fuel Filter

NOTICE
Refer to "Precautions," in this section, BEFORE proceeding.

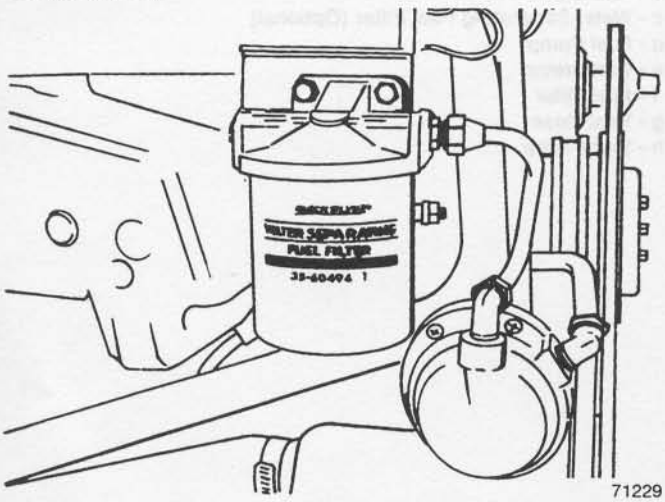
The water separating fuel filter is standard on some engines and can also be purchased as an option for engines not equipped with it.

The fuel filter consists of the fuel filter base and filter element.



27534

5.0 - 5.7 Litre
350 Magnum



71229

454/502 and 7.4/8.2 Litre Generation V Engines

27532

454/502 and 7.4/8.2 Litre, Except Generation V Engines

Replacement

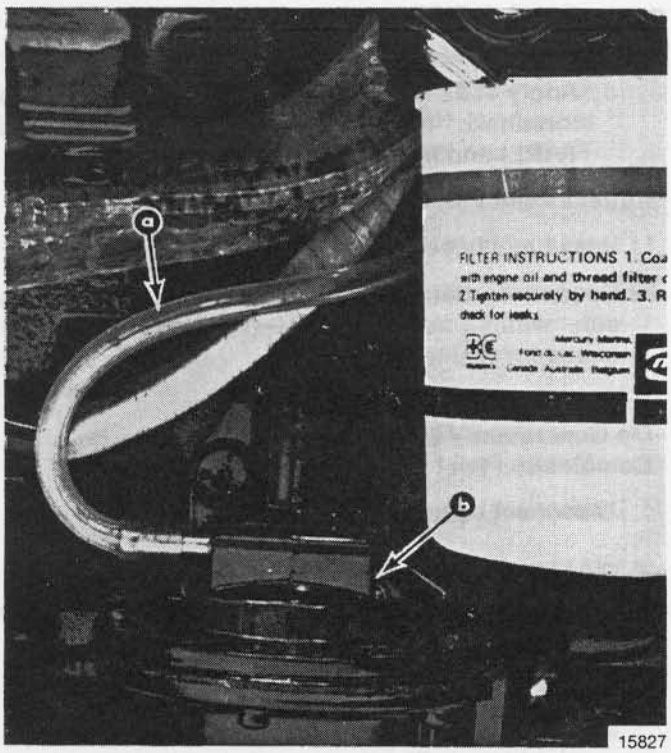
NOTICE
Refer to "Precautions," in this section, BEFORE proceeding.

1. Disconnect battery cables from battery.
2. Remove fuel filter from base by turning filter counterclockwise. A filter wrench may be needed to loosen element.
3. Lubricate sealing ring(s) of new filter with SAE engine oil.
4. Install new filter, tightening securely by hand.
5. Reconnect battery cables, start engine (making sure water is supplied to cooling system), and check for fuel leaks.

Sight Tube

Inspection

Fuel pump are equipped with sight tube. Evidence of fuel in the sight tube indicates a ruptured diaphragm and fuel pump must be replaced immediately.



a - Sight Tube
b - Fuel Pump

Testing Fuel Pump

NOTICE
Refer to "Precautions," in this section, BEFORE proceeding.

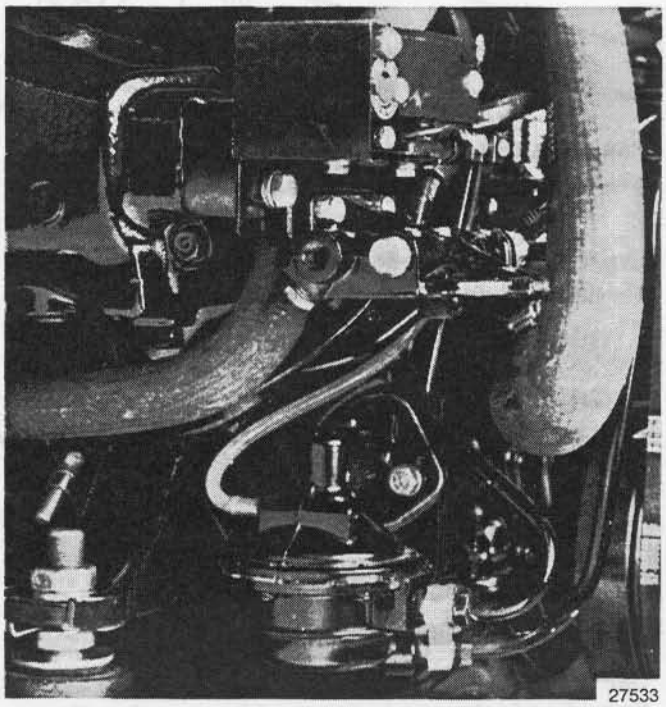
1. Disconnect battery cables from battery.
2. Remove fuel line from carburetor or outlet side of fuel pump.
3. Install Fuel Pressure Connector 91-18078 to carburetor or fuel pump and reinstall fuel line. Tighten connector and fuel line securely.
4. Connect fuel pressure test gauge to connector.
5. Reconnect battery cables, start engine, and run at 1800 RPM.
6. Fuel pressure should be with-in specifications. If not, replace fuel pump.

Fuel Pump

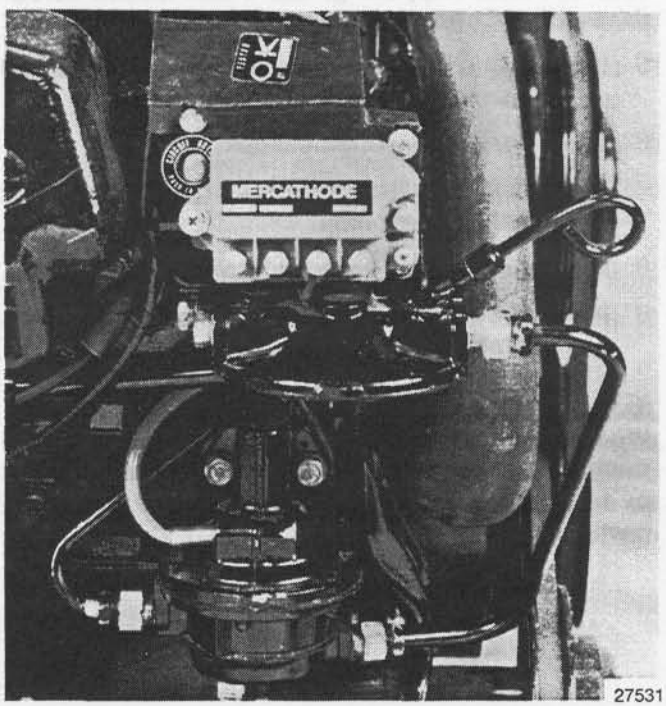
Replacement

NOTICE
Refer to "Precautions," in this section, BEFORE proceeding.

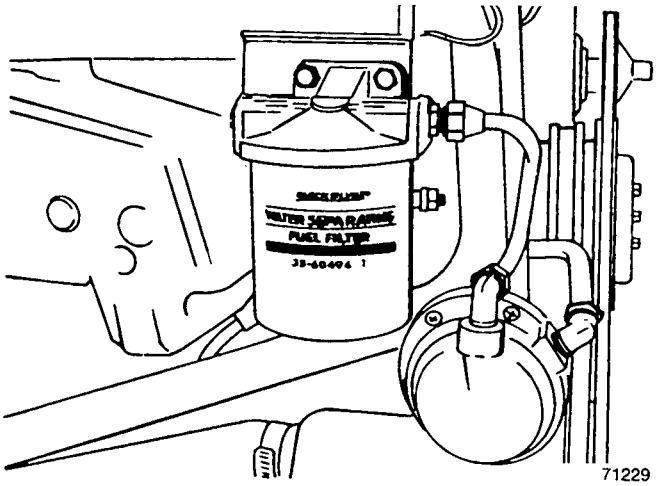
IMPORTANT: The fuel pump cannot be repaired. If pump fails, it must be replaced.



5.0 - 5.7 Litre Fuel Pump



7.4 - 8.2 Litre Fuel Pump (Except Generation V Engines)



71229

454/502 and 7.4/8.2 Litre Generation V Engines (Seawater Pump with Combination Fuel Pump)

On All Engines Except Generation V Engines (Seawater Pump with Combination Fuel Pump)

1. Disconnect battery cables from battery.

⚠CAUTION
Plug fuel supply hose after removal to prevent fuel from leaking into boat.

2. Remove fuel supply hose from filter base and plug to prevent fuel from leaking into boat.
3. Remove fuel filter.
4. Remove fuel lines from fuel pump.

IMPORTANT: Fuel pump push rod will fall out of position when fuel pump is removed from engine. To prevent this from happening, use a thin bladed screwdriver to hold push rod up while removing fuel pump.

5. Using a thin bladed screwdriver to hold push rod up, remove fuel pump.
6. Clean gasket from engine block.
7. Apply Perfect Seal to both sides of fuel pump gasket and install on fuel pump.
8. Install fuel pump. Torque bolts to 25 lb. ft. (34 N.m).
9. Install fuel inlet and oulet fittings to fuel pump as outlined next.

⚠CAUTION
When installing brass fittings or plugs into a new fuel pump or fuel filter base, the following instructions must be used to prevent cracking the pump or filter base castings.

a. Apply #592 Loctite Pipe Sealant with Teflon to threads of fittings or plugs (DO NOT USE TEFLON TAPE).

b. Thread fittings or plugs into fuel pump or filter base until finger-tight.

c. Use a wrench to tighten fitting or plug an additional 1-3/4 to 2-1/4 turns. DO NOT OVER-TIGHTEN.

d. Apply #592 Loctite Pipe Sealant with Teflon to threads of fuel line (DO NOT USE TEFLON TAPE) and install. Tighten securely.

10. Install sight tube.
11. Install fuel hose and fuel filter.
12. Reconnect battery cables, start engine (making sure water is supplied to cooling system), and check for fuel leaks.

On Generation V Engines (Seawater Pump with Combination Fuel Pump)

1. Disconnect battery cables from battery.

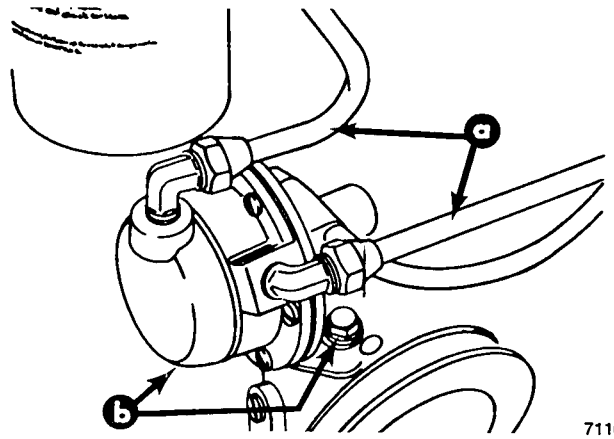
⚠CAUTION
Plug fuel supply hose after removal to prevent fuel from leaking into boat.

2. Follow instructions "a" - "c":

   a. Disconnect fuel lines from fuel pump (including sight tube). Plug fuel supply line to prevent fuel from leaking into boat.

   b. Remove fasteners securing fuel pump to seawater pump housing.

   c. Remove fuel pump.



71169

a - Fuel Lines
b - Fasteners (2) - One Hidden In This View

IMPORTANT: Avoid contamination of gear lube inside seawater housing. Do not allow old gasket material or dirt to enter the opening on the seawater pump housing where the fuel pump was removed.

3. Clean gasket from seawater pump housing.
4. Apply Perfect Seal to both sides of fuel pump gasket and install on seawater pump housing.
5. Install fuel pump. Torque screws to 25-28 lb. ft. (34-38 N·m).
6. Connect fuel lines to fuel pump and tighten securely.
7. Connect sight tube securely to pump.
8. Reconnect battery cables. Tighten clamps securely.
9. Start engine (MAKE SURE water is being supplied to cooling system), and check for fuel leaks.

Fuel Pump Push Rod

NOTE: On Generation V Engines no fuel pump push rod is present. The pump is operated by an eccentric lobe (slip-ring) inside the seawater pump housing. Refer to SECTION 6A - Seawater Cooled Models, for more information.

NOTICE
Refer to "Precautions," in this section, BEFORE proceeding.

Removal

1. Remove fuel pump as outlined.
2. a. On 5.0 - 5.7 litre engines, remove fuel pump plate from engine block to remove push rod.
   b. On 7.4 - 8.2 litre engines, remove pipe plug from below fuel pump mount to remove push rod.
3. Measure push rod length. Replace if not 5.76 in. (146.304mm) long.

Installation

1. Coat push rod with Quicksilver Needle Bearing Lubricant and install in engine.
2. a. On 5.0 - 5.7 litre engines, install fuel pump cover (with new gasket). Tighten screws securely.
   b. On 7.4 - 8.2 engines, coat threads of pipe plug with Perfect Seal and install. Tighten securely.
3. Reinstall fuel pump as outlined.

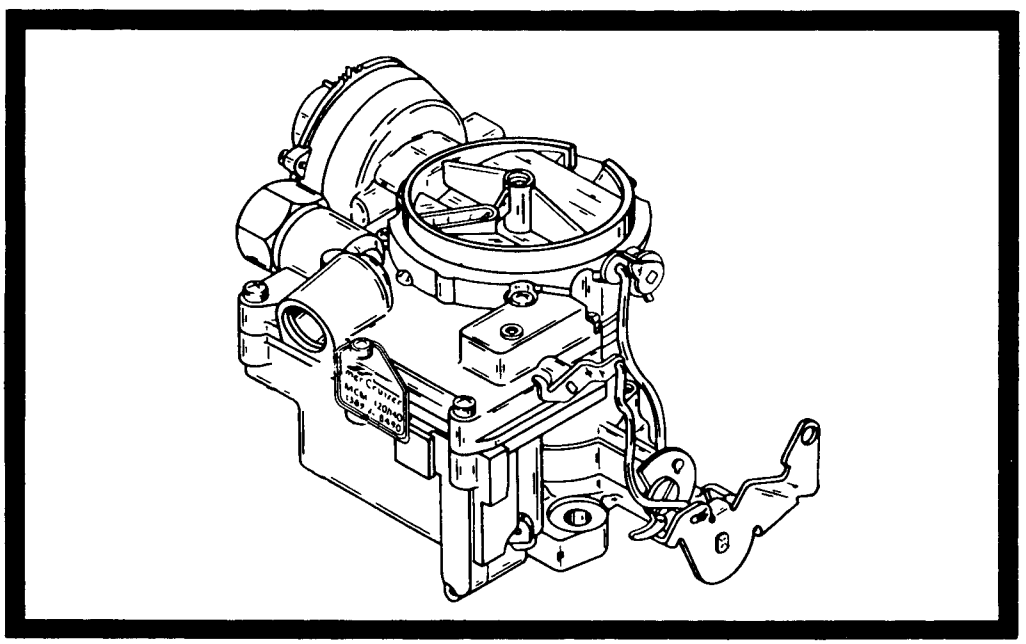
Measuring the Push Rod's Camshaft Lobe

NOTE: On Generation V Engines fuel pump is operated by an eccentric slip-ring inside the seawater pump housing. Use an inspection light and inspect eccentric lobe for heavy wear or galling. Polished appearance on slip-ring and/or pump lever is acceptable. Refer to SECTION 6A - Seawater Cooled Models, if wear patterns appear unacceptable, and service the unit as outlined.

NOTICE
Refer to "Precautions," in this section, BEFORE proceeding.

1. Remove fuel pump as outlined.
2. a. On 5.0 - 5.7 litre engines, remove fuel pump plate from engine block.
   b. On 7.4 - 8.2 litre engines, remove pipe plug from below fuel pump mount.
3. Measure total movement of push rod while turning engine over two complete revolutions. If measurement is less than .344 in. (8.738mm), replace camshaft.

FUEL SYSTEM



MERCARB® 2 BARREL

5

B

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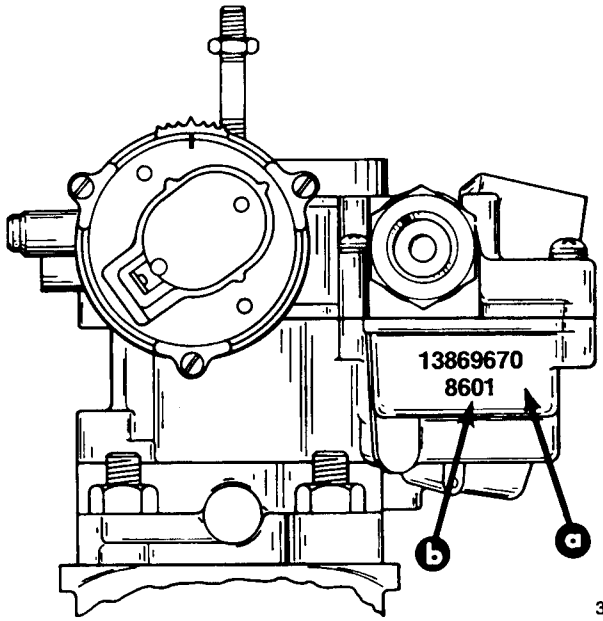
Identification



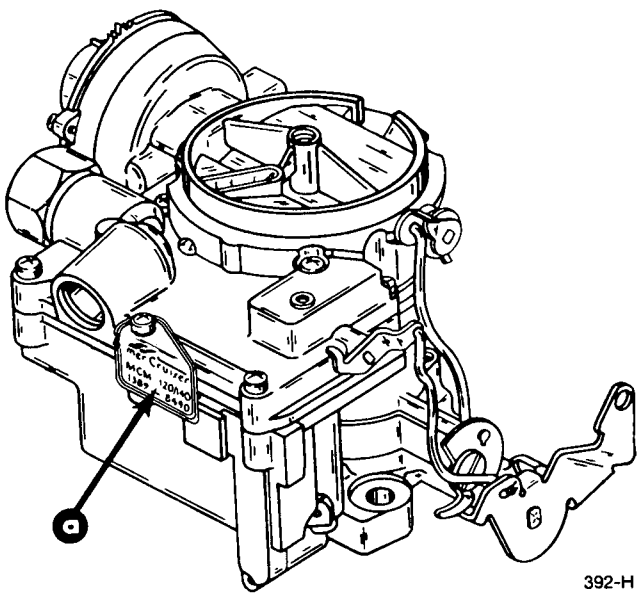
384-H

a - Part Number
b - Date Code

Carburetor Part Number Location

Date Code Explanation: Example 4501

First Figure is Year
8 = 1988, 9 = 1989, etc.
Second Figure is Month
5 = May, 6 = June, 7 = July, etc.
X = October, Y = November, Z = December
Third and Fourth Figure is Day of Month
01 = First day, 02 = Second day, etc.



392-H

a - Part Number

Part Number Tag Location

Replacement Parts Warning

⚠WARNING

Electrical, ignition and fuel system components on your MerCruiser are designed and manufactured to comply with U.S. Coast Guard Rules and Regulations to minimize risks of fire and explosion.

Use of replacement electrical, ignition or fuel system components, which do not comply with these rules and regulations, could result in a fire or explosion hazard and should be avoided.

Torque Specifications

Fastener Location	Lb. Ft. (N.m)
Carburetor to Manifold	20 (27)
Fuel Line to Carburetor	18 (24)
Fuel Inlet Filter Nut	18 (24)

Tools

MERCURY MARINE SPECIAL TOOLS	
79-17391A1	Tachometer
91-36392	Universal Carburetor Gauge

BORROUGHS TOOL and EQUIPMENT 2429 N. BURDICK ST. KALAMAZOO, MI 49007 (616) 345-5163	
BT 8128B	Float Gram Scale

Specifications

UNIT OF MEASUREMENT in. (mm)

CARBURETOR ADJUSTMENT SPECIFICATIONS (Note 1)

Engine Model	5.0 Litre
Carburetor Type	MerCarb® 35mm
Carburetor Number	1389 - 9670
Float Level (Note 2)	3/8 (10)
Float Drop (Note 2)	1-5/64 (27)
Pump Rod	1-5/32 (29)
Choke Setting	Index Marks Aligned
Idle Mixture Screw Preliminary Setting	1-1/4 Turns
Float Weight	9 Grams Max.
Primary Jet Size	.072 (1.85)
Power Valve Size	4 -- .039 (1.00)

NOTES: 1. All measurements are ± 1/64 in. (0.4mm)

2. Measurement is taken from gasket. Fuel inlet needle is a solid two-piece type.

Description

This MerCarb carburetor is a two bore carburetor and has a separate fuel feed for each venturi. This model also is equipped with an electric choke. A removable venturi cluster (secured to float bowl assembly) has the calibrated main well tubes and pump jets built into it. The venturi cluster is serviced as a unit. The serviceable main metering jets are fixed orifice type that work together with fixed air bleeds to properly meter the correct fuel/air mixture to the engine.

Precautions

⚠WARNING
Always disconnect battery cables from battery BEFORE working on fuel system to prevent fire or explosion.

⚠WARNING
Be careful when cleaning flame arrestor and crankcase ventilation hose; gasoline is extremely flammable and highly explosive under certain conditions. Be sure that ignition key is "OFF". DO NOT smoke or allow sources of spark or open flame in area when cleaning flame arrestor and crankcase ventilation hose.

⚠WARNING
Be careful when changing fuel system components; gasoline is extremely flammable and highly explosive under certain conditions. Be sure that ignition key is "OFF". DO NOT smoke or allow sources of spark or flame in the area while changing fuel filter. Wipe up any spilled fuel immediately.

⚠WARNING
Make sure no fuel leaks exist, before closing engine hatch.

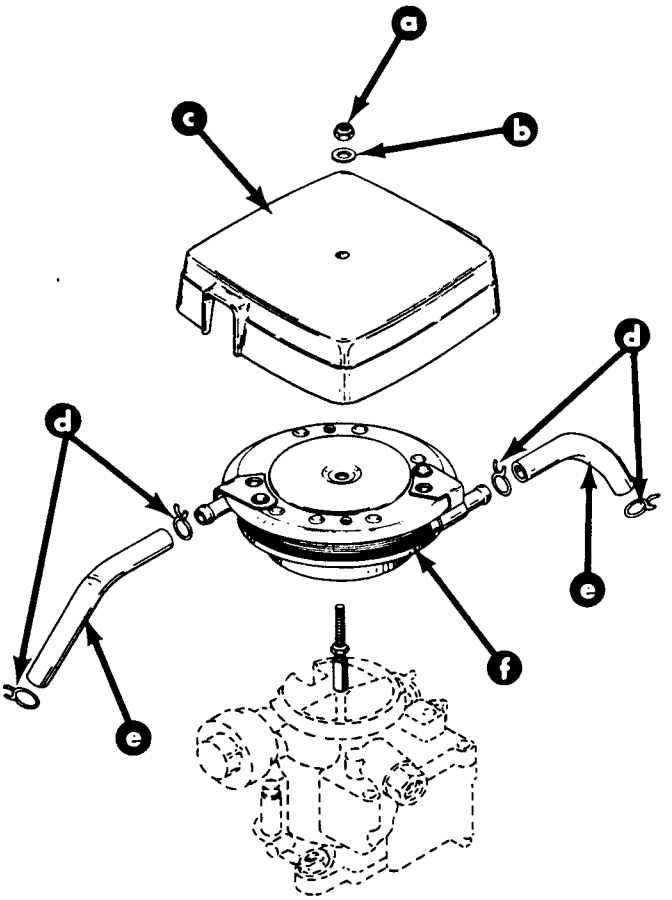
⚠CAUTION
DO NOT operate engine without cooling water being supplied to water pickup holes in gear housing, or water pump impeller will be damaged and subsequent overheating damage to engine may result.

Maintenance

Flame Arrestor with Carburetor Cover

NOTICE
Refer to "Precautions," in this section, BEFORE proceeding.

1. Remove in the following order:
   a. Nut.
   b. Sealing washer.
   c. Carburetor cover.
   d. Crankcase ventilation hoses from flame arrestor and rocker arm covers.
   e. Flame arrestor.
2. Clean and inspect:
   a. Clean flame arrestor in solvent and blow dry with compressed air.
   b. Clean crankcase ventilation hoses.
   c. Inspect crankcase ventilation hoses for cracks or deterioration, and replace if necessary.
3. Install in the following order:
   a. Flame arrestor.
   b. Crankcase ventilation hoses to flame arrestor and rocker arm covers.
   c. Carburetor cover.
   d. Sealing washer.
   e. Nut - Tighten securely.



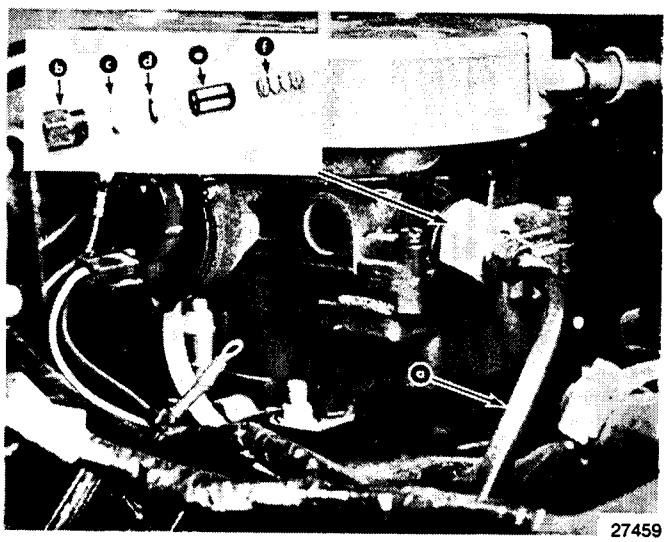
a - Nut
b - Sealing Washer
c - Carburetor Cover
d - Clamps
e - Crankcase Ventilation Hoses
f - Flame Arrestor

Flame Arrestor with Carburetor Cover (Typical)

Fuel Inlet Filter

NOTICE
Refer to "Precautions," in this section, BEFORE proceeding.

1. Remove in the following order:
   a. Fuel line from fuel inlet filter nut.
   b. Fuel inlet filter nut.
   c. Large gasket.
   d. Filter.
   e. Spring.
   f. Small gasket - From inside filter nut.



a - Fuel Line
b - Fuel Inlet Filter Nut
c - Gasket (Large)
d - Gasket (Small)
e - Filter
f - Spring

Carburetor Fuel Inlet Filter

2. Clean filter nut and spring in solvent and dry with compressed air.
3. Install in the following order:
   a. Spring - Place in carburetor body.
   b. Filter - Open end to inlet filter nut.
   c. Small gasket - Place inside filter nut.
   d. Large gasket - Place over filter nut.
   e. Fuel inlet filter nut - Torque to 18 lb. ft. (24 N.m).
   f. Fuel line - Torque to 18 lb. ft. (24 N.m).

Choke Inspection

The choke does not require any periodic maintenance; however, if a choke malfunction is suspected, the following should be done:

1. With engine off, remove flame arrestor.
2. Open and close choke several times, and check for binding, loose or disconnected linkages, or other signs of damage.
3. If choke or linkage binds, sticks, or works sluggishly, clean with carburetor choke cleaner. Follow directions on can.

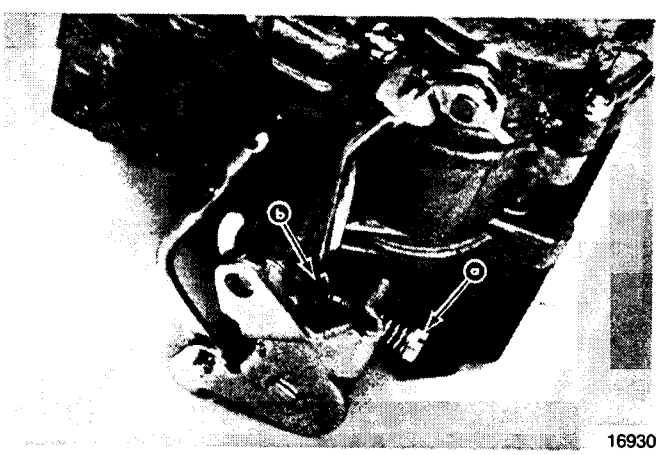
IMPORTANT: Choke valve and shaft and lever assembly is not serviceable. If valve and/or shaft and lever assembly is worn or damaged, air horn assembly must be replaced.

Adjustments

NOTICE
Refer to "Precautions," in this section, BEFORE proceeding.

Pump Rod

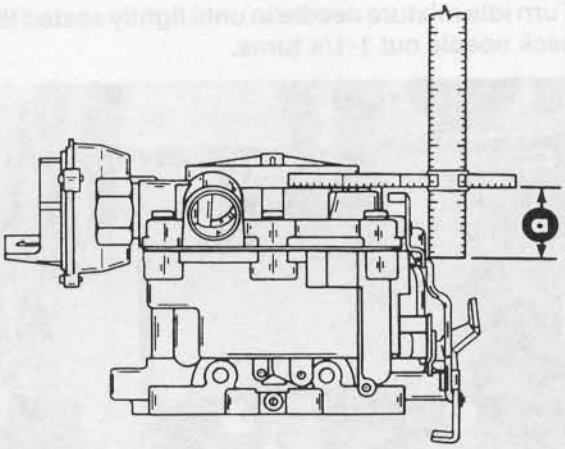
1. Back out idle speed screw until it no longer contacts idle cam.



a - Idle Speed Screw
b - Idle Cam

Backing Out Idle Speed Screw

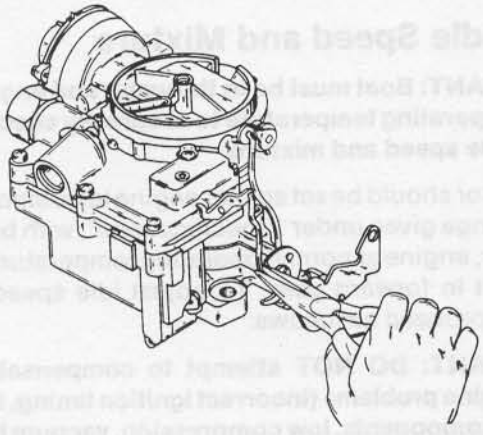
2. With throttle valves completely closed, measure from flame arrestor mounting surface to top of pump rod.



a - See Specifications

Measuring Pump Rod

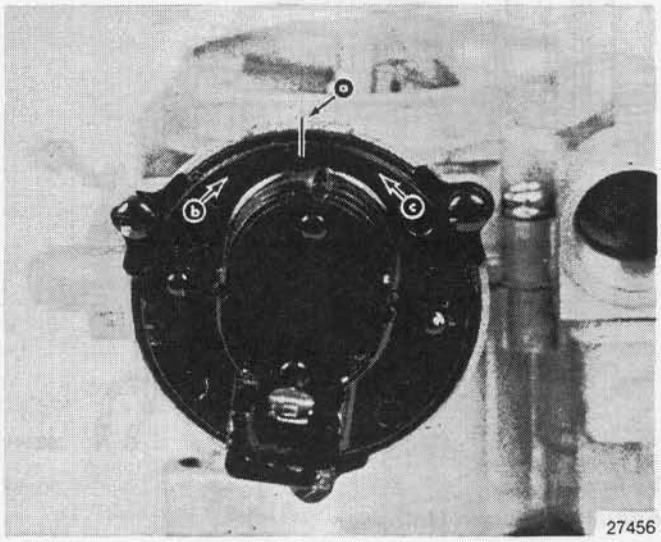
3. Carefully bend pump rod (where shown) to obtain specified dimension.



Adjusting Pump Rod

Choke Setting

Normal choke setting is such that scribed mark on cover is in line with long case mark on choke housing.



a - Index Marks
b - Leaner
c - Richer

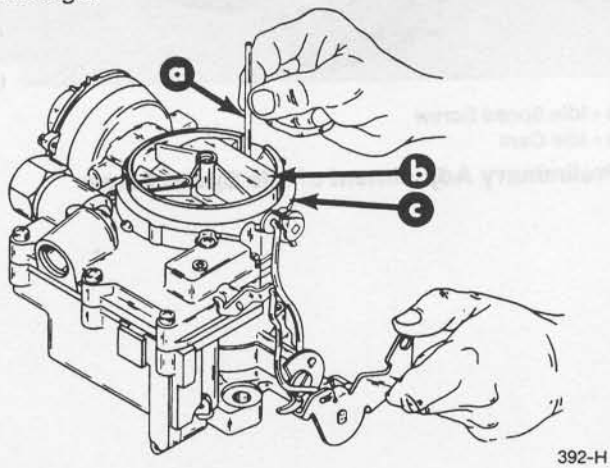
Choke Setting

If choke adjustment is necessary:

1. Loosen 3 choke cover retaining screws and adjust as shown.
2. Tighten 3 choke cover retaining screws securely.

Choke Unloader

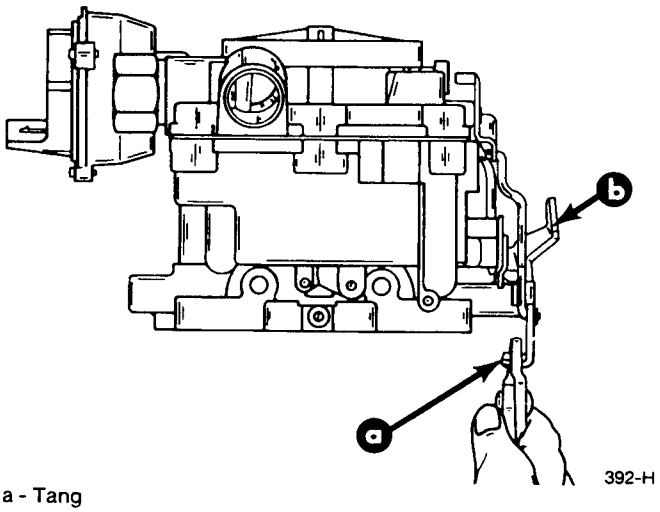
1. Hold throttle valves completely open.
2. Gently press down on choke plate.
3. Using an .080 in. (2.0mm) drill rod, or appropriate gauge, slide rod between upper edge of choke plate and air horn assembly. Rod should just slide through.



a - .080 in. (2.0mm) Drill Rod
b - Choke Plate
c - Air Horn

Checking Choke Unloader

4. Bend tang on throttle lever, if necessary, to obtain specified dimension.



392-H

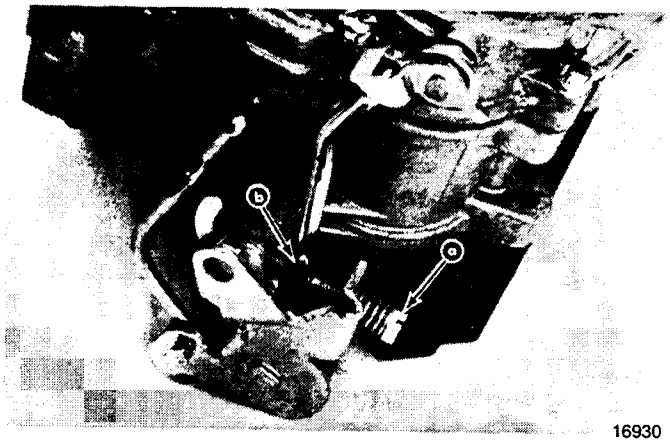
a - Tang
b - Throttle Lever

Adjusting Choke Unloader

Preliminary Idle Speed and Mixture

IMPORTANT: The following adjustments will provide a sufficient idle speed and mixture for starting engine. Final adjustments must be made with engine running.

1. Turn idle speed screw in until it just contacts idle cam: then, turn screw in an additional two turns.



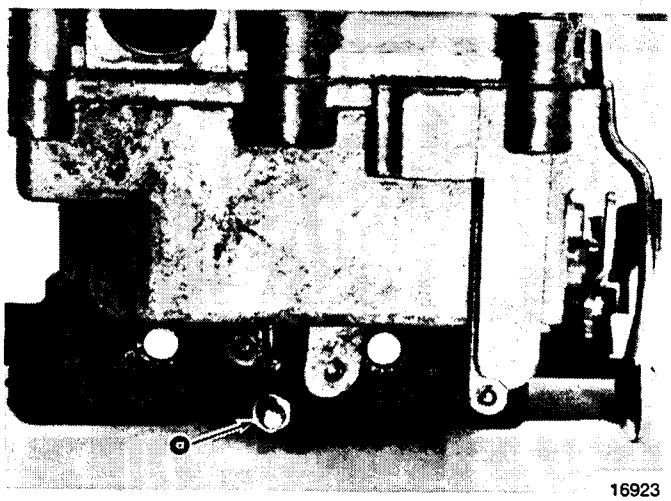
16930

a - Idle Speed Screw
b - Idle Cam

Preliminary Adjustment of Idle Speed Screw

IMPORTANT: DO NOT turn idle mixture needle tightly against seat (in the following step), as damage to seat and/or needle may result.

2. Turn idle mixture needle in until lightly seated then, back needle out 1-1/4 turns.



16923

a - Idle Mixture Needle

Preliminary Idle Mixture Adjustment

Final Idle Speed and Mixture

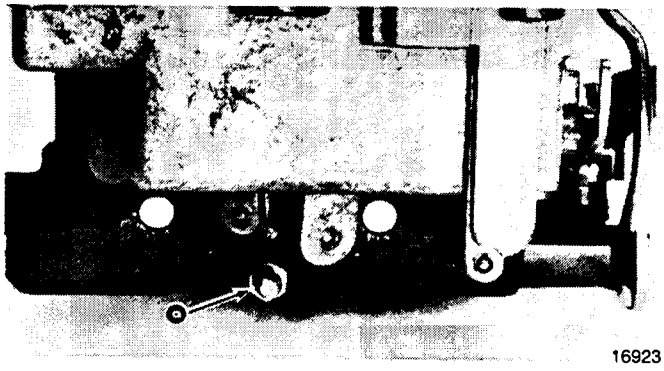
IMPORTANT: Boat must be in the water and engine at normal operating temperature to accurately check and adjust idle speed and mixture.

Carburetor should be set so that engine idles smoothly within range given under "Specifications", with boat in the water, engine at normal operating temperature and drive unit in forward gear. To adjust idle speed and mixture, proceed as follows:

IMPORTANT: DO NOT attempt to compensate for other engine problems (incorrect ignition timing, faulty ignition components, low compression, vacuum leaks, etc.) with carburetor adjustments. This will only cover the problem, which must be corrected if engine is to achieve maximum fuel economy and performance.

1. Connect an accurate shop tachometer to engine.

IMPORTANT: DO NOT turn idle mixture needle tightly into seat, as damage to needle and/or seat may result.



16923

a - Idle Mixture Needle

Carburetor Idle Mixture Needle

2. If a new or rebuilt carburetor has been installed, turn idle mixture needle in (clockwise) until lightly contacts seat; then, back out needle 1-1/4 turns. This will provide a sufficient setting to allow starting engine.
3. Start engine and run at 1500 RPM until engine reaches normal operating temperature.

⚠WARNING

DO NOT leave the helm unoccupied while performing idle speed and mixture adjustments, following. BE CAREFUL NOT TO ACCIDENTALLY ACCELERATE ENGINE WHILE PERFORMING ADJUSTMENTS.

4. With boat in open water, place remote control in forward gear, idle position.
5. Disconnect throttle cable brass barrel from anchor stud. Be sure not to lose spacer on anchor stud.
6. Adjust idle speed adjustment screw to obtain specified RPM.
7. With engine running at specified RPM, adjust idle mixture needle as follows:
   a. Turn idle mixture needle inward (clockwise) until the engine speed begins to drop due to lean mixture.
   b. Turn idle mixture screw outward (counterclockwise) until the speed begins to drop due to rich mixture.
   c. Turn screw inward to a point between these two extremes to obtain maximum engine smoothness and RPM.
   d. Readjust idle speed adjusting screw, if necessary, to obtain specified RPM.

IMPORTANT: Refer to "Section 2 (Removal, Installation and Alignment)" for throttle cable installation and adjustment.

Repair

NOTICE

Refer to "Precautions," in this section, BEFORE proceeding.

Removal

IMPORTANT: Carburetor malfunctions are, in many cases, caused by the presence of dirt, water or other foreign matter in carburetor. To aid in diagnosis, carefully remove carburetor from engine without draining fuel from bowl. Contents of fuel bowl may, then, be inspected for contamination as carburetor is disassembled.

1. Remove ventilation hose from flame arrestor; then, remove flame arrestor.

IMPORTANT: Place a clean cloth in bores of carburetor to prevent dirt and foreign material from falling into bores.

2. Turn fuel supply off at fuel tank.
3. Disconnect throttle cable from carburetor.
4. Remove swivel link assembly from carburetor.
5. Remove fuel line from fuel inlet nut.
6. Remove fuel pump sight tube from carburetor.
7. Disconnect electric choke.
8. Remove carburetor attaching nuts and washers and remove carburetor.
9. Remove and discard gaskets.

IMPORTANT: Place a clean cloth over intake manifold opening to prevent dirt or foreign material from entering manifold.

Installation

1. Thoroughly clean gasket surfaces.
2. Place new carburetor base gasket on intake manifold. Install carburetor and secure with nuts and washers. Torque to 132 lb. in. (15 N.m).
3. Connect fuel line to fuel inlet nut and torque to 18 lb. ft. (24 N.m).
4. Connect fuel pump sight tube to fitting on carburetor.
5. Connect electric choke wires to choke cover.
6. Check to ensure that 8-12 threads of link rod are exposed from swivel; then, attach swivel link assembly to throttle lever, using nut and washer.
7. Move intermediate throttle lever back-and-forth and check for binding in throttle linkage. If binding occurs, remove swivel link assembly from throttle lever and adjust link (by turning link rod), as required, to eliminate binding.
8. Install throttle cable, as explained, in "Section 2."
9. Install flame arrestor and crankcase ventilation hose.
10. Reconnect battery cables to battery.
11. Start engine and check for gasoline leaks. If leaks exist, STOP ENGINE IMMEDIATELY and recheck connections.
12. Adjust idle speed and idle mixture, as outlined under "Adjustments" preceding.

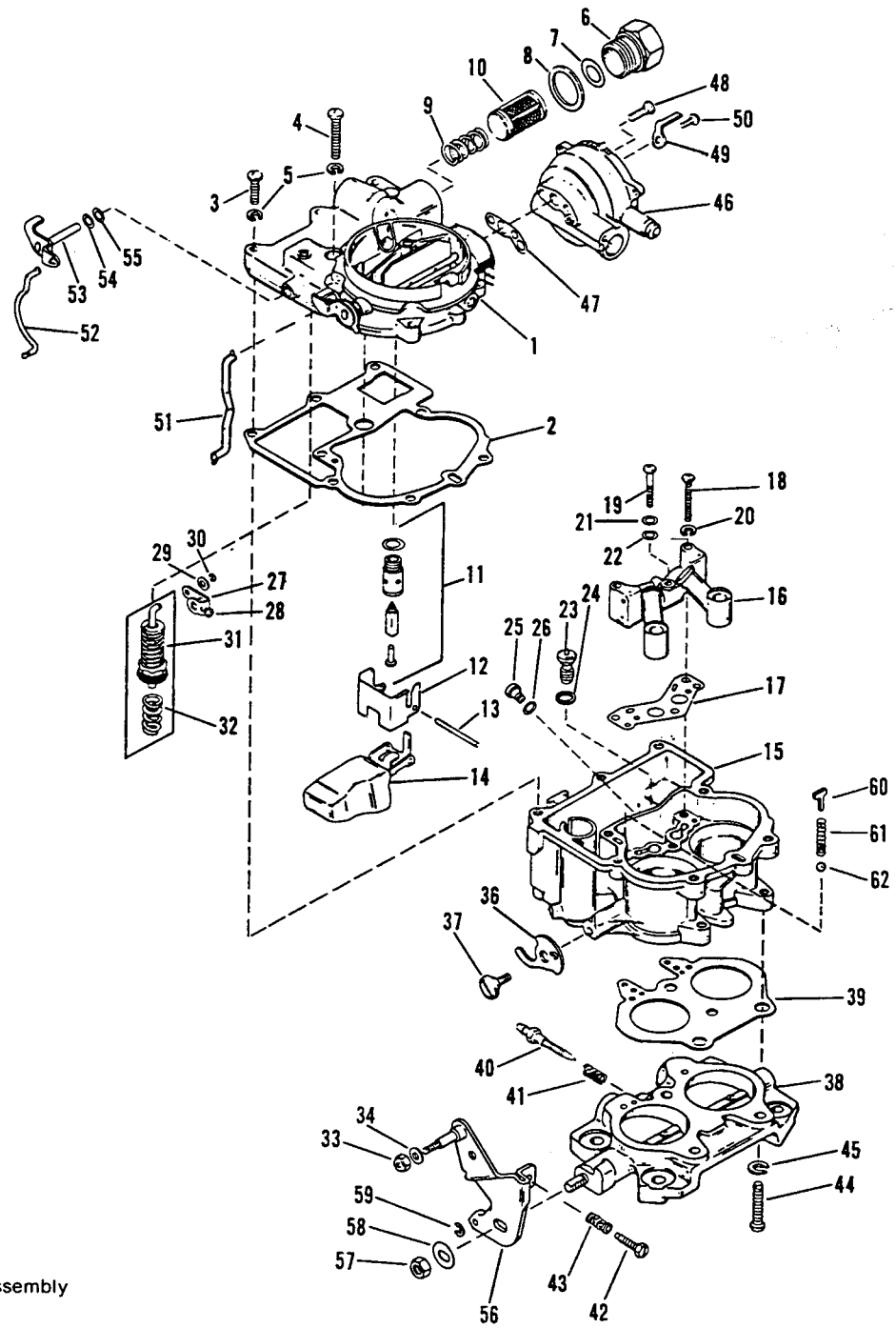
Disassembly

The following is a step-by-step procedure for completely over-hauling carburetor removed from engine. In many cases, however, complete overhaul is not necessary and, in these cases, only the steps required to repair the carburetor malfunction should be performed. Read the instructions carefully to prevent doing any unnecessary steps.

IMPORTANT: Before performing any service on carburetor, it is essential that carburetor be placed in a holding fixture to prevent possible damage to throttle valves.

MerCarb Two-Barrel

1 - Air Horn
2 - Gasket
3 - Screw
4 - Screw
5 - Lockwasher
6 - Nut - Fuel Inlet
7 - Gasket
8 - Gasket
9 - Spring
10 - Filter
11 - Inlet Needle and Seat
12 - Baffle Plate
13 - Pin
14 - Float
15 - Float Bowl
16 - Venturi Cluster
17 - Gasket
18 - Screw
19 - Screw
20 - Lockwasher
21 - Washer - Flat
22 - Gasket
23 - Power Valve Assembly
24 - Gasket
25 - Jet
26 - Gasket
27 - Pump Shaft and Lever Assembly
28 - Screw
29 - Washer
30 - Clip - Retainer
31 - Accelerator Pump Assembly
32 - Spring
33 - Nut
34 - Washer
35 - Cam - Idle
36 - Screw
37 - Throttle Body
38 - Gasket
39 - Idle Mixture Adjusting Needle
40 - Spring
41 - Screw - Idle Speed Adjusting
42 - Spring
43 - Screw
44 - Lockwasher
45 - Choke/Housing
46 - Gasket
47 - Screw
48 - Lever Assembly
49 - Screw
50 - Rod - Choke
51 - Rod - Accelerator Pump
52 - Accelerator Pump Shaft and Lever Assembly
53 - Washer - (Outer)
54 - Washer - (Inner)
55 - Throttle Lever
56 - Nut
57 - Washer - Locking
58 - Clip - Pump Rod
59 - Retainer
60 - Spring
61 - Check Ball



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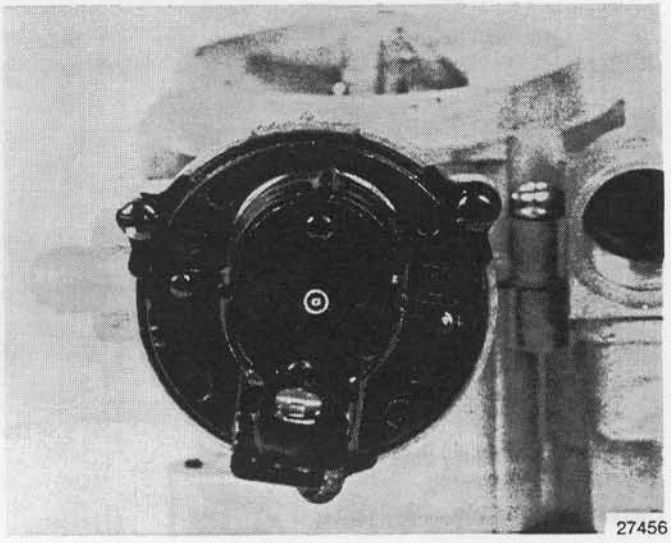
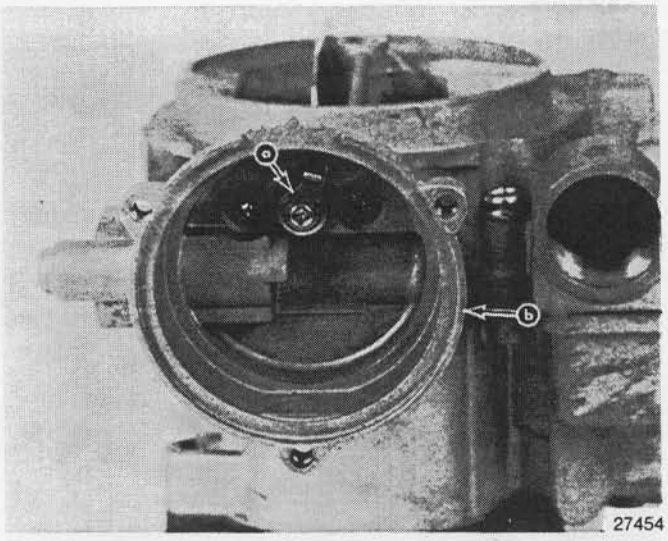
CHOKE HOUSING ASSEMBLY

1. Remove choke cover (a).

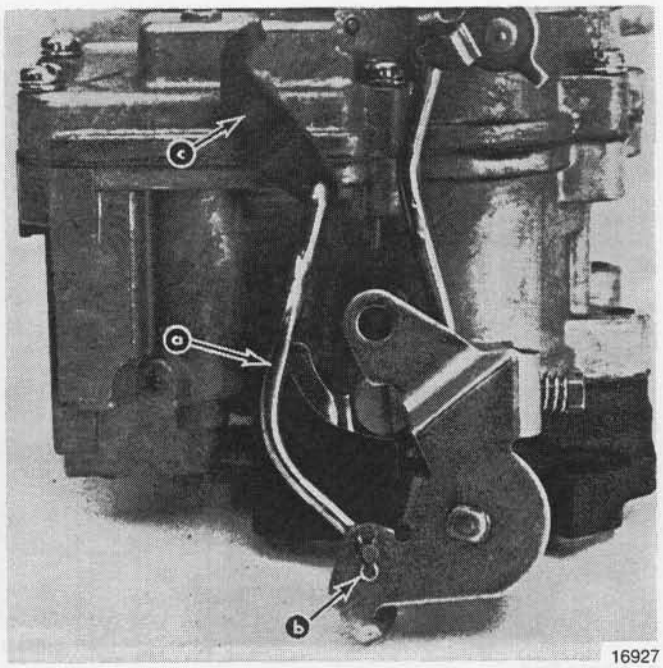


2. Remove choke lever (a). Remove choke housing (b).



AIR HORN

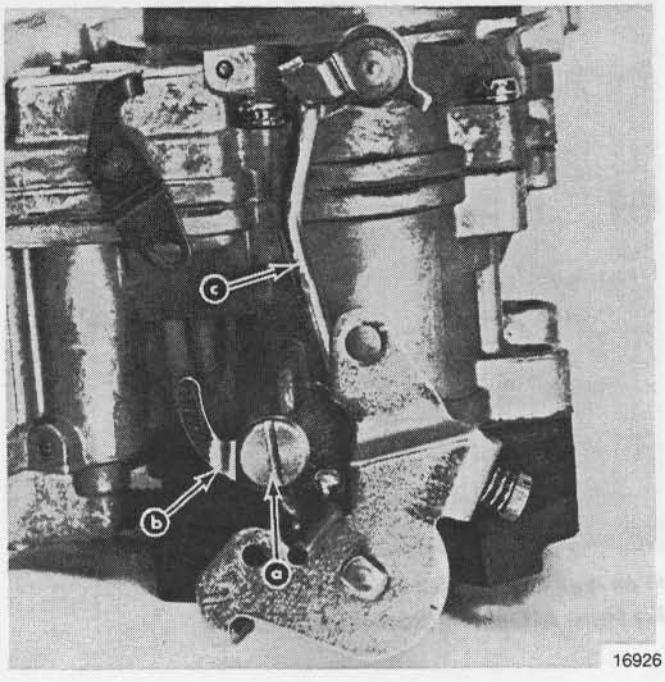
1. Remove fuel inlet filter nut, washers, spring, and filter, as outlined.
2. Remove accelerator pump rod retaining clip. Pivot rod (as required) until retaining ear on rod and slot in pump shaft and lever assembly align, allowing rod to be pulled out.



a - Accelerator Pump Rod
b - Retainer Clip
c - Pump Shaft and Lever Assembly

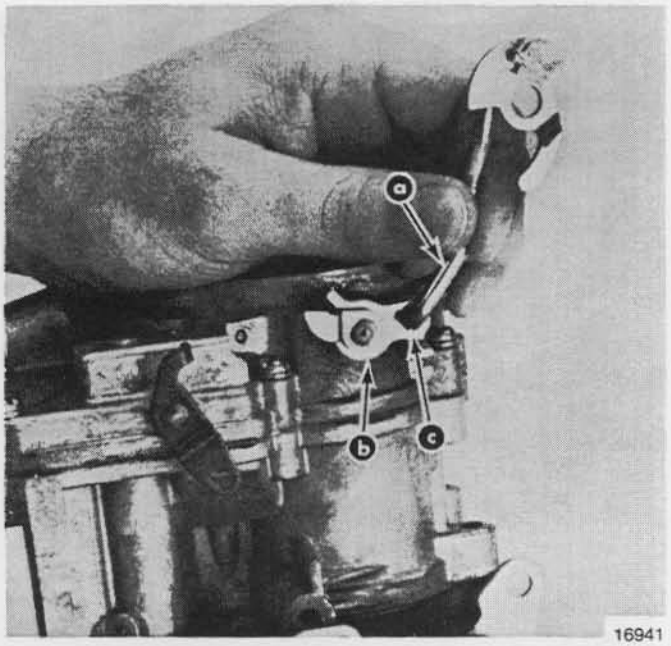
Removing Accelerator Pump Rod

3. Remove idle cam screw. Also, remove choke rod by pivoting rod (as required) until retaining ear on rod and slot in choke lever align, allowing rod to be pulled out.



a - Idle Cam Screw
b - Idle Cam
c - Choke Rod

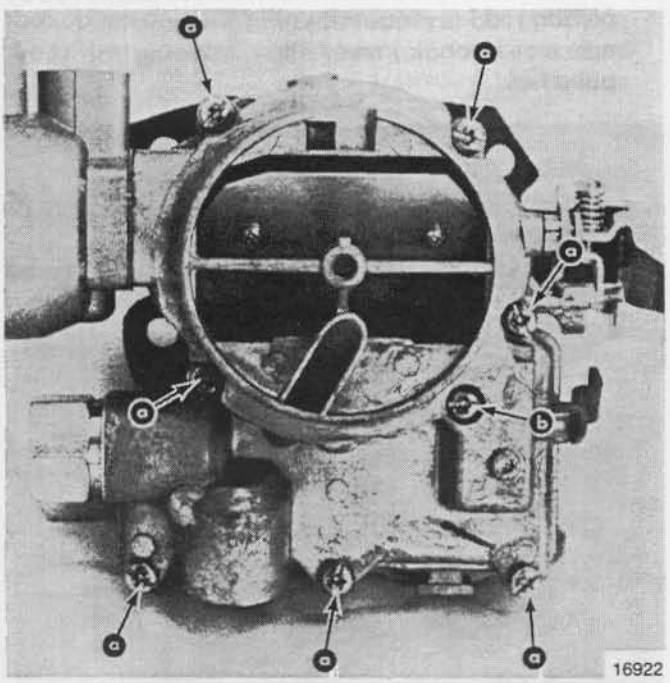
Removing Idle Cam



a - Choke Rod
b - Choke Lever
c - Slot

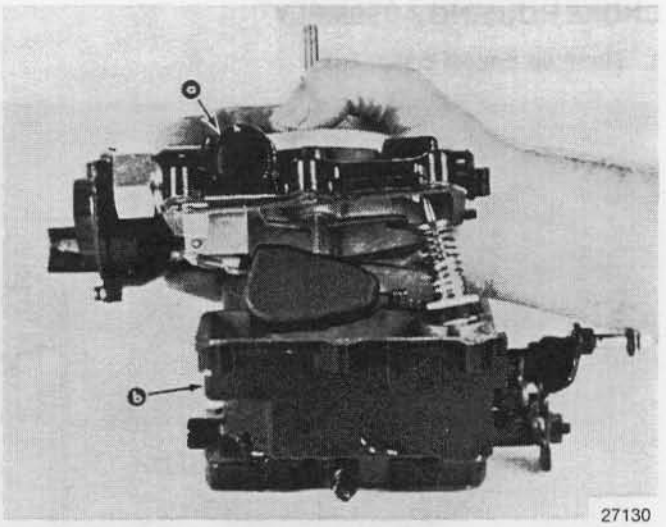
Removing Choke Rod

4. Remove air horn as shown.



a - Air Horn Attaching Screws

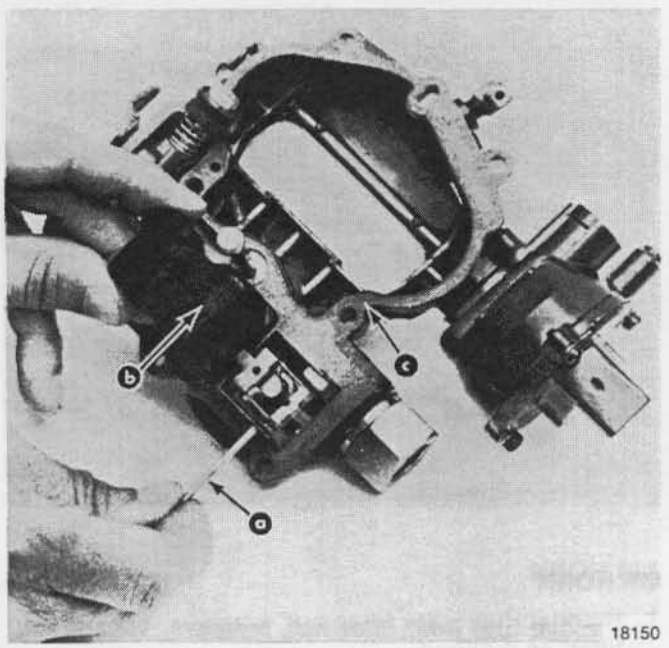
Air Horn Attaching Screw Location



a - Air Horn - Carefully Lift Off
b - Float Bowl Assembly

Carefully Removing Air Horn

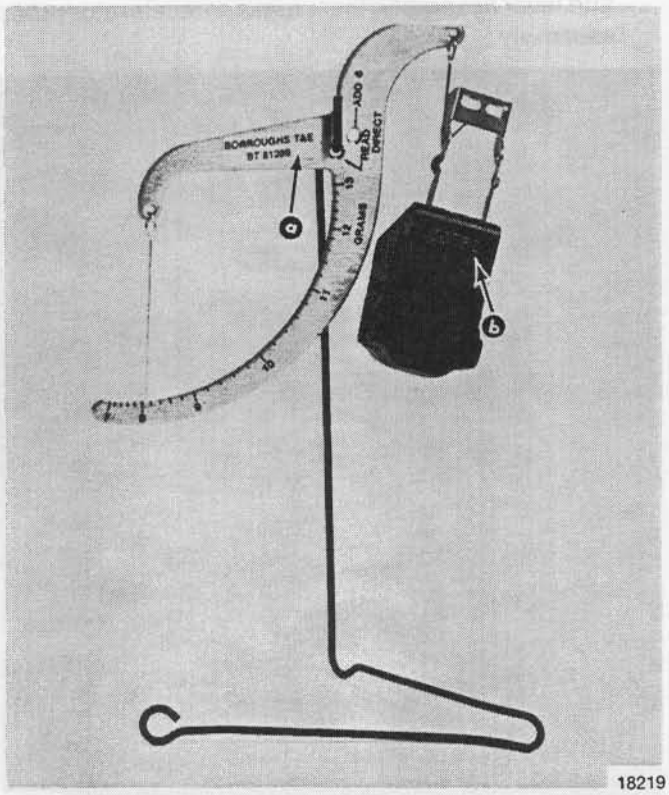
5. Invert air horn and carefully lay on bench.
6. Remove float hinge pin and lift float assembly from air horn.



a - Float Hinge Pin
b - Float Assembly
c - Air Horn Gasket

Removing Float Assembly

7. Check float weight as shown.

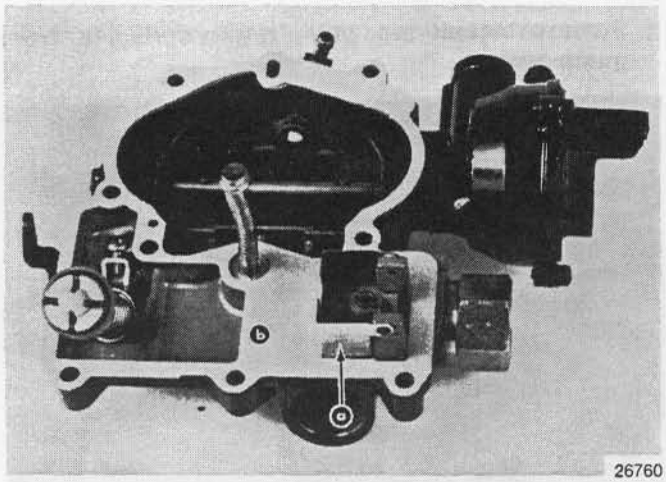


18219

a - Grams Scale
b - Float

Checking Float Weight

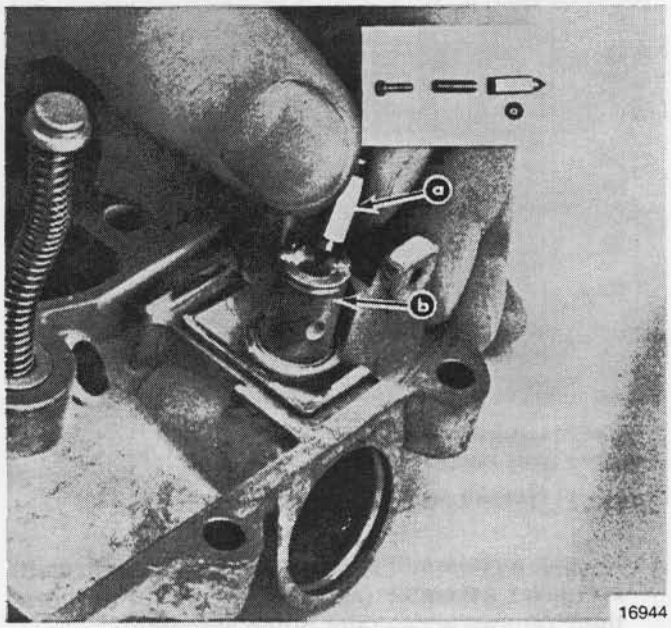
8. Remove air horn gasket and baffle.



26760

a - Baffle
b - Gasket

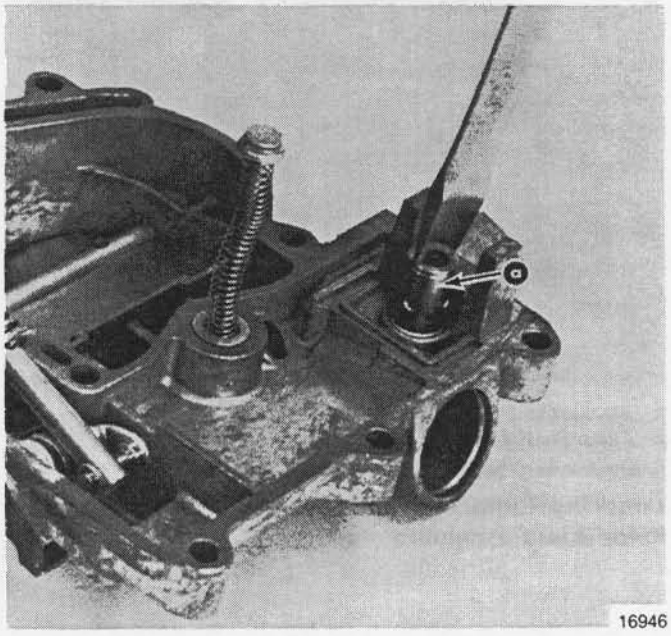
9. Remove needle assembly.



16944

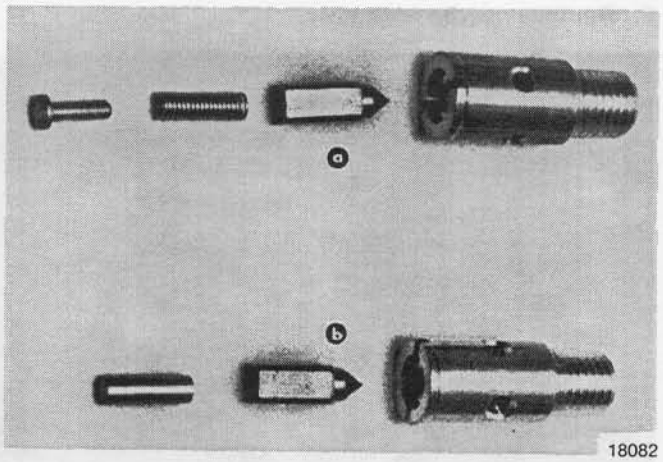
a - Needle Assembly
b - Needle Seat

10. Remove seat.



16946

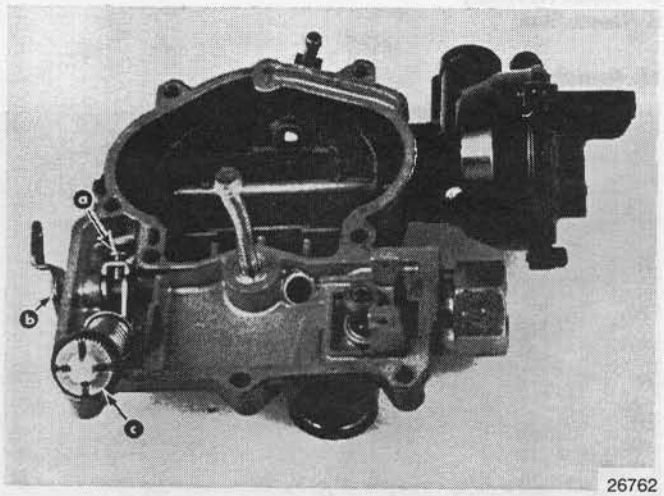
a - Seat



a - "Spring Loaded Type" Needle
b - "Solid Type" Needle

Types of Needle and Seat Assemblies

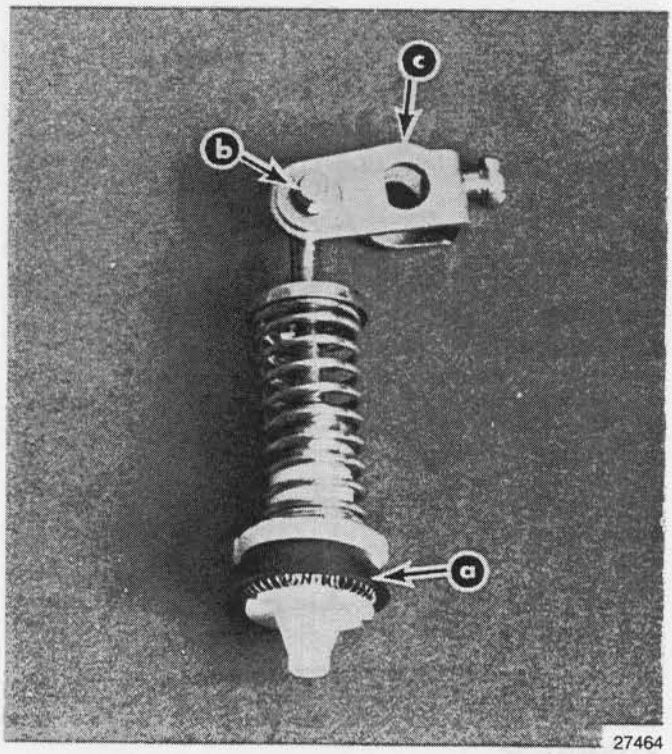
11. Loosen accelerator pump screw. Slide pump shaft and lever assembly (and washer) out of air horn; then, remove accelerator pump assembly.



a - Accelerator Pump Screw
b - Pump Shaft and Lever Assembly
c - Accelerator Pump

Removing Pump Shaft and Lever Assembly and Accelerator Pump Assembly

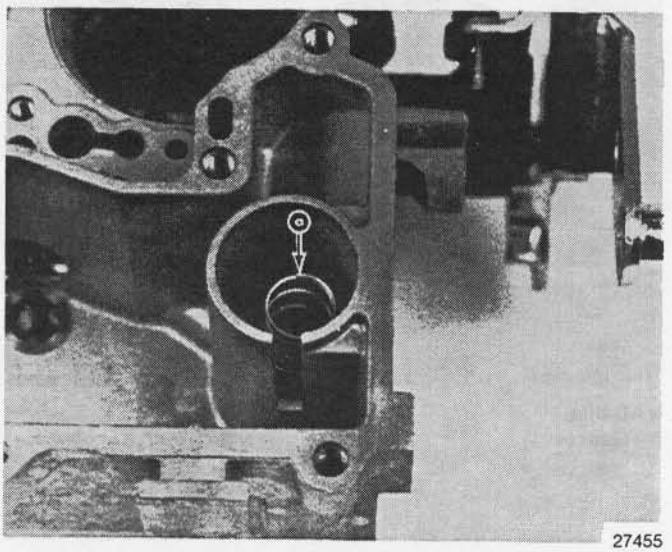
12. Remove retainer clip and washer from pump shaft and lever assembly; then, remove accelerator pump assembly.



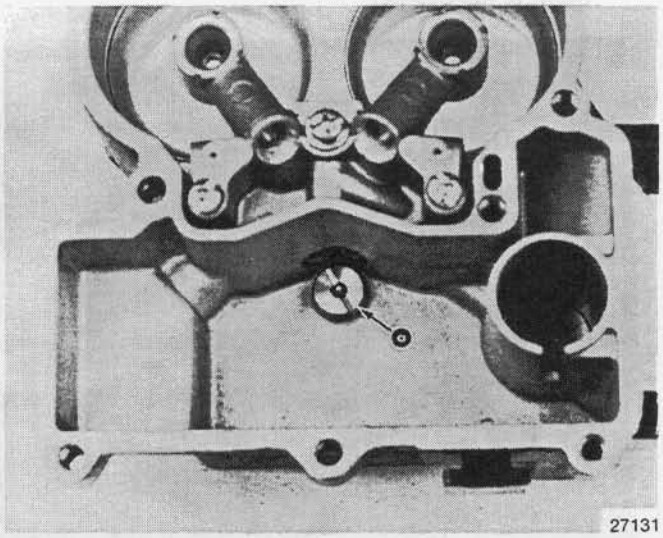
a - Accelerator Pump Assembly
b - Retainer Clip and Washer
c - Lever Assembly

FLOAT BOWL ASSEMBLY

1. Remove accelerator pump return spring (a) from pump well.



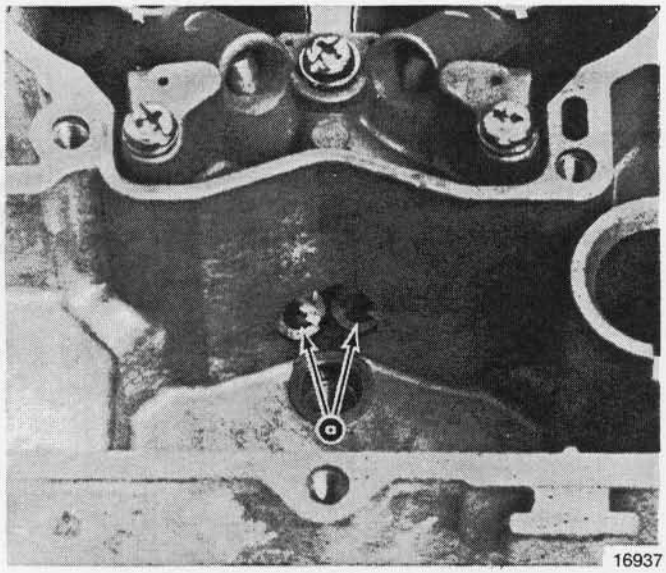
2. Remove power valve assembly and gasket.



a - Power Valve Assembly and Gasket

Removing Power Valve Assembly

3. Remove main metering jets.

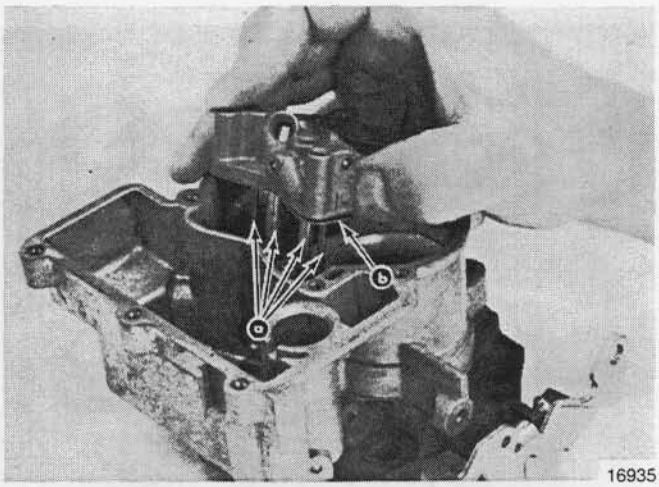


a - Main Metering Jets

Removing Main Metering Jets

IMPORTANT: Use care when removing venturi cluster to prevent damaging brass tubes protruding from bottom of cluster. DO NOT REMOVE TUBES. These tubes are permanently pressed into the venturi cluster and are not replaceable.

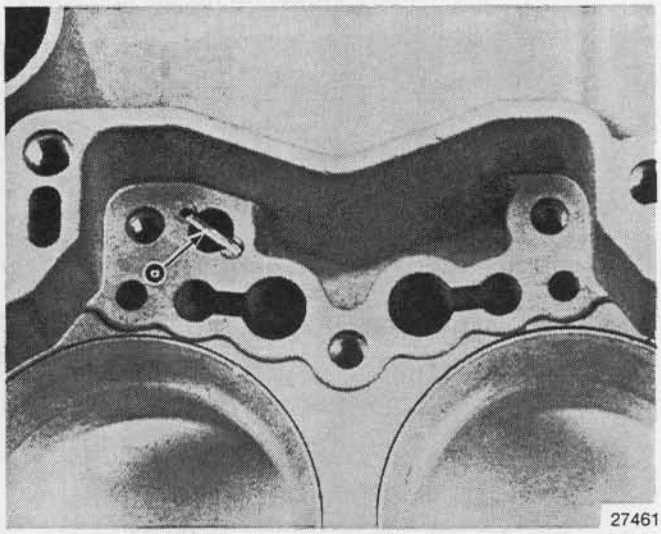
4. Remove three venturi cluster screws, and carefully remove cluster and venturi gasket.



a - Venturi Cluster Brass Tubes
b - Gasket

Carefully Remove Venturi Clusters

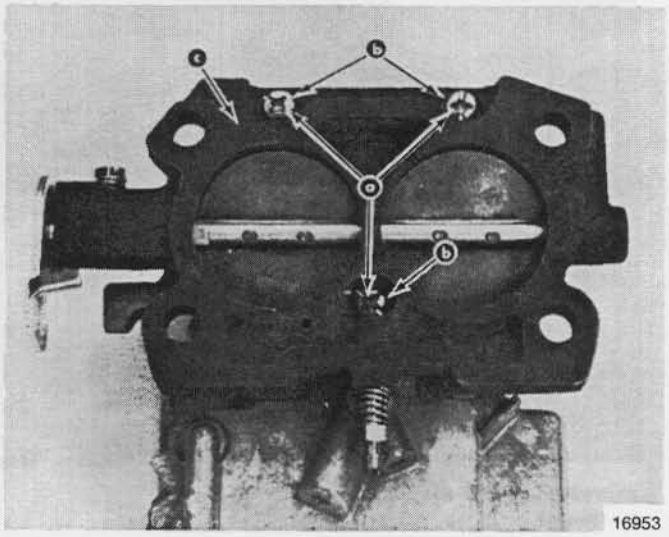
5. Using a needle-nose pliers, remove accelerator pump check ball spring retainer (a). Turn float bowl over to remove spring and check ball.



THROTTLE BODY ASSEMBLY

IMPORTANT: Use extreme care when handling throttle body, so as not to damage throttle valves.

1. Place float bowl assembly upside down. Remove three throttle body assembly attaching screws and lockwashers, and remove throttle body and gasket from float bowl.

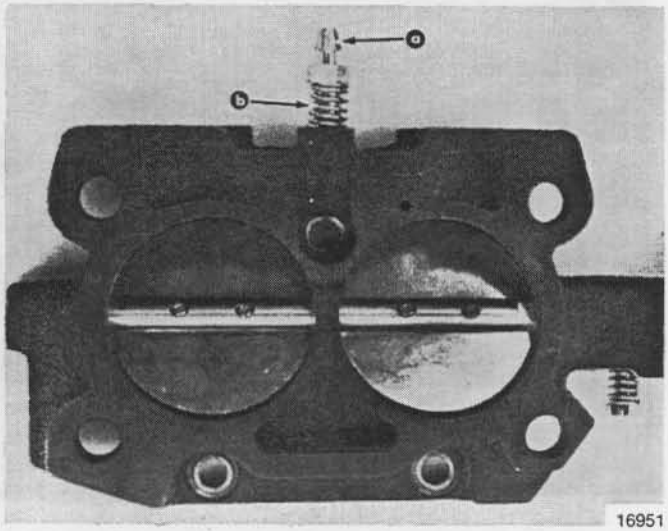


16953

a - Screws
b - Lockwashers
c - Throttle Body

Separating Throttle Body from Float Bowl Assembly

2. Remove idle mixture adjusting needle and spring.

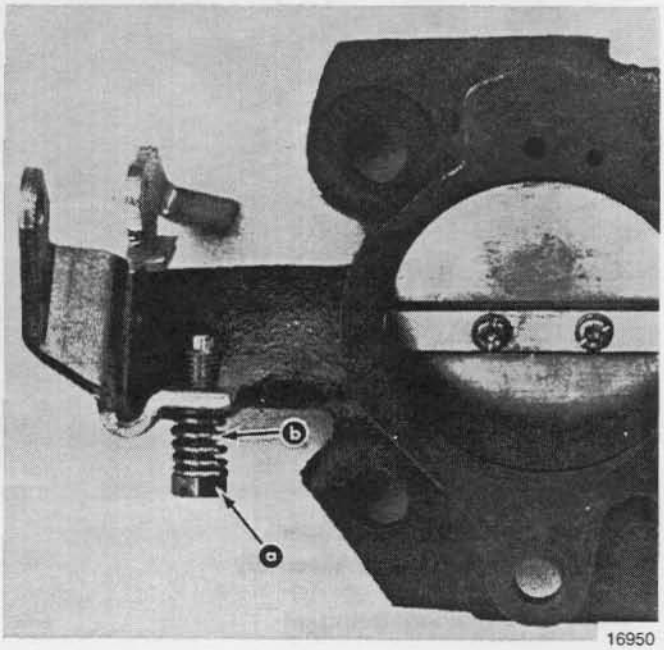


16951

a - Idle Mixture Adjusting Needle
b - Spring

Removing Idle Adjusting Needle and Spring

3. Remove idle speed screw and spring, if replacement is necessary.



16950

a - Idle Speed Screw
b - Spring

Removing Idle Speed Screw and Spring

IMPORTANT: DO NOT remove throttle valves. If any of the throttle body parts are found to be worn or damaged, complete throttle body assembly MUST BE replaced.Throttle body assembly can be cleaned in carburetor cleaner.

Cleaning and Inspection

IMPORTANT: DO NOT use a wire or drill to clean jets, passages, or tubes in carburetor, as this may enlarge orifices and seriously affect carburetor calibration.

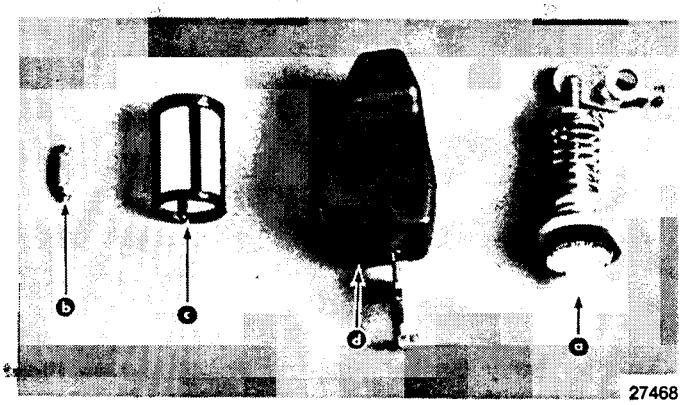
⚠CAUTION

Do not leave carburetor in carb cleaner for more than two hours.

IMPORTANT: DO NOT clean float bowl gasket surfaces with a gasket scraper or knife, as sealing bead will be damaged and float bowl replacement will be necessary.

⚠CAUTION

The float assembly, float needle, accelerator pump plunger, and fuel filter MUST NOT BE immersed in carburetor cleaner, as they will swell, harden, and/or distort.



a - Accelerator Pump
b - Float Needle
c - Fuel Filter
d - Float Assembly

Items Which MUST NOT BE Immersed in Carburetor Cleaner

1. Thoroughly clean all metal parts in a commercial carburetor cleaner, until all deposits have been removed. Follow manufacturer's instructions of cleaner being used for proper cleaning and rinsing procedure. Dry parts with compressed air.
2. Using compressed air, blow out all passages in carburetor to remove any foreign material.
3. Wipe-off all parts that cannot be cleaned in carburetor cleaner with a clean, dry cloth.
4. Carefully inspect all carburetor parts for wear and damage; pay particular attention to the following:

   a. **Float Needle and Seat:** If float needle or seat is worn or damaged, replace with a new needle and seat assembly.

IMPORTANT: Float needle and seat are factory matched and tested and should be replaced as a set only.

   b. **Float Assembly and Hinge Pin:** Check float density (to see if it is saturated with fuel), by comparing weight of float with specifications. If weight is high, float assembly must be replaced. Check hinge pin and holes for wear.

   c. **Fuel and Air Passages:** Passages must be perfectly clean for proper carburetor operation.

   d. **Accelerator Pump Plunger and Return Spring:** Inspect pump plunger cup, pump plunger spring (on pump assembly) and return spring.

   e. **Power Piston Spring:** Check power piston spring for weakness or distortion.

   f. **Idle Mixture Needle:** Inspect idle mixture needle. If damaged, needle must be replaced.

   g. **Levers and Linkages:** Check levers, links and rods for wear.

   h. **Throttle Valve and Shaft:** Check throttle shaft for excessive looseness in throttle body. Check throttle valve and shaft for binding thru entire operating range, making sure valve opens and closes completely. Throttle body assembly must be replaced if throttle valve and shaft are worn or damaged.

   i. **Choke Valve and Shaft and Lever Assembly:** Check shaft and lever assembly for excessive looseness in air horn assembly. Check choke valve and shaft and lever assembly for binding thru entire operating range, making sure valve opens and closes completely. Air horn assembly must be replaced if choke valve and shaft and lever assembly are worn or damaged.

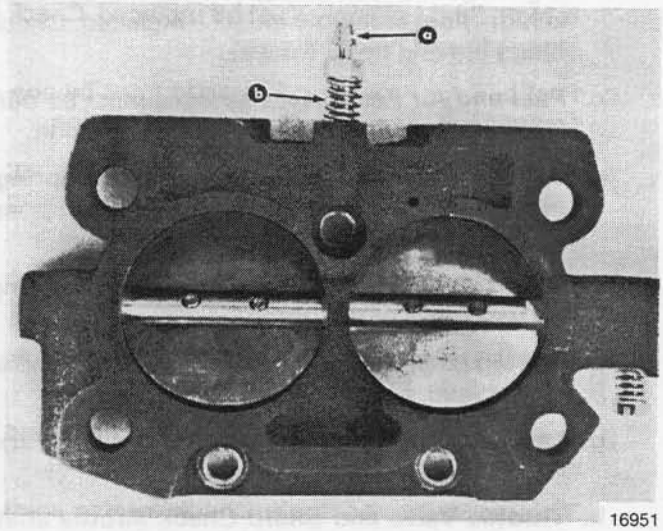
   j. **Inspect Casting** for visible damage. Inspect gasket surfaces. Inspect accelerator pump plunger well for scoring or deposits.

Reassembly

THROTTLE BODY ASSEMBLY

IMPORTANT: DO NOT force idle mixture needle against seat as damage to needle and/or seat will result.

1. Screw idle mixture needle (and spring) into throttle body until they lightly seat; then, back out needle 1-1/4 turns as a preliminary idle mixture setting. Final adjustment will be made with engine running. Refer to "Adjustments."

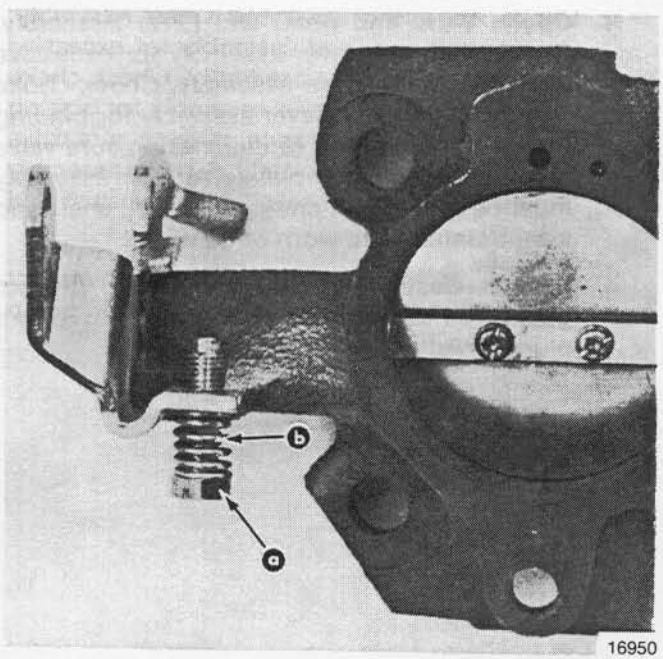


16951

a - Idle Mixture Needle
b - Spring

Installing Idle Mixture Adjusting Needle and Spring

2. Thread idle speed screw and spring into throttle lever.

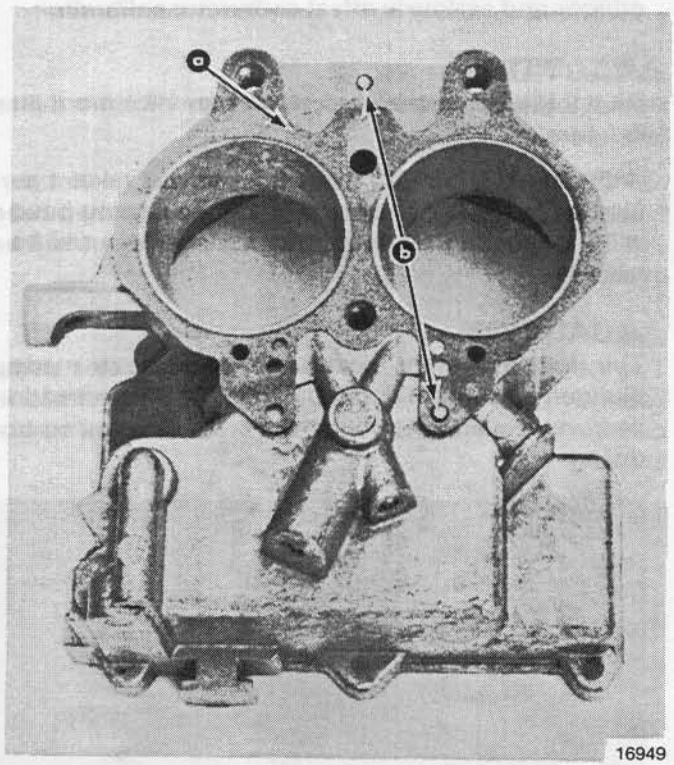


16950

a - Idle Speed Screw
b - Spring

Installing Idle Speed Screw

3. Turn float bowl assembly upside-down and place new throttle body gasket on bowl, making sure gasket is properly positioned on locating dowel.

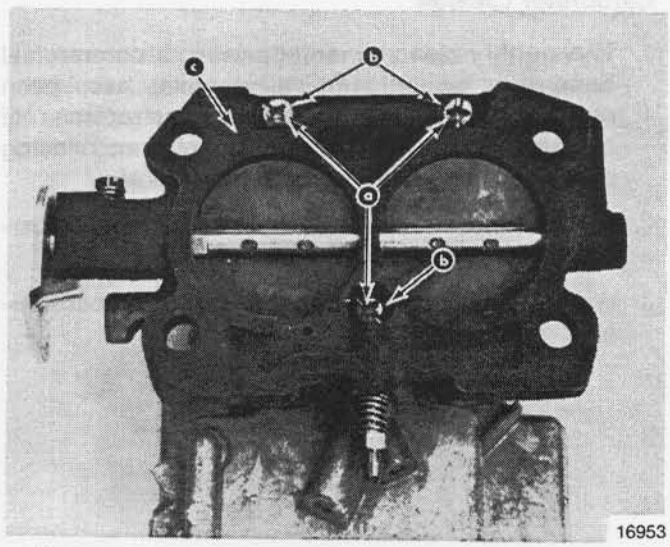


16949

a - Throttle Body Gasket
b - Locating Dowel

Throttle Body Gasket Properly Positioned on Float Bowl Assembly

4. Install throttle body assembly on float bowl assembly, making sure that screw holes in gasket line up with screw holes in throttle body. Tighten screws evenly and securely.



16953

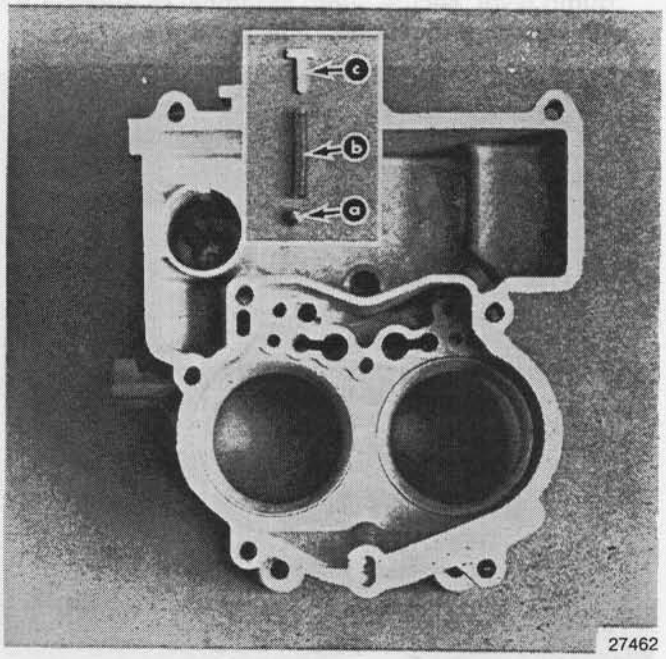
a - Screws
b - Lockwashers
c - Throttle Body Assembly

Installing Throttle Body Assembly on Float Bowl Assembly

FLOAT BOWL ASSEMBLY

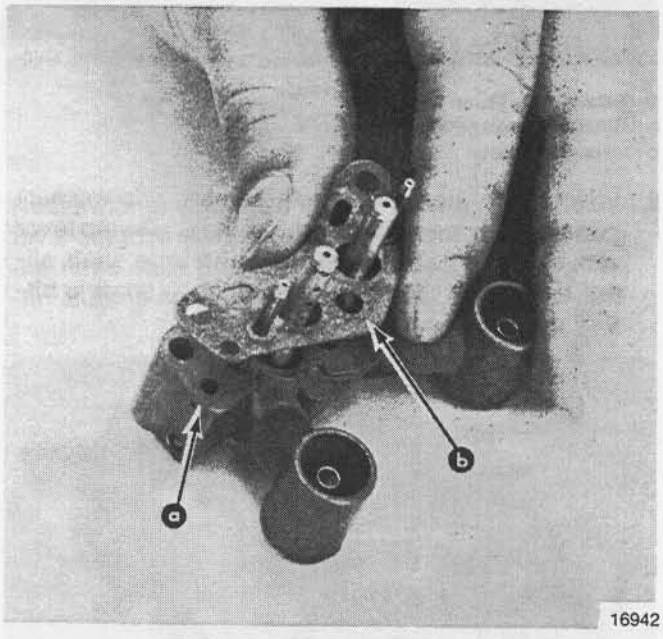
IMPORTANT: Place float bowl and throttle assemblies in holding fixture to prevent throttle valves from being damaged.

1. Install checkball (a), spring (b), and retainer (c) in passage as shown. Push retainer firmly into slots.



27462

2. Install new gasket on venturi cluster as shown.

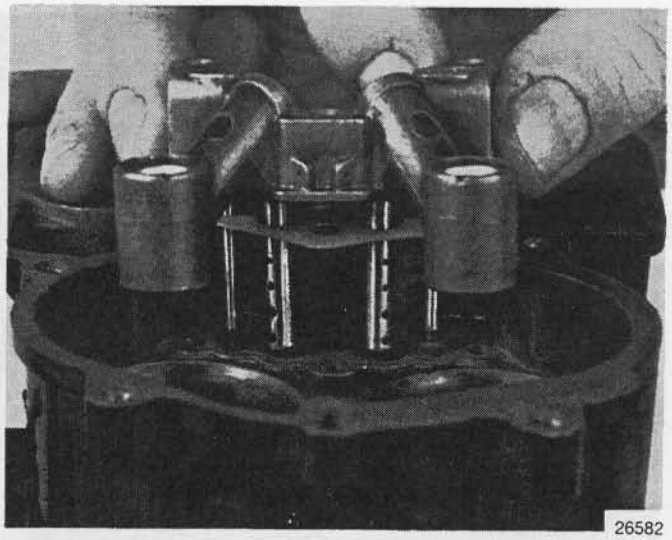


16942

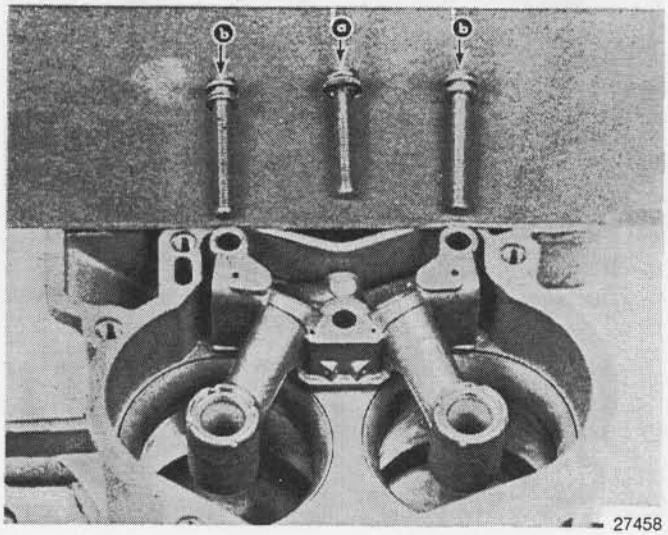
a - Venturi Cluster
b - Gasket

Placing Gasket on Venturi Cluster

3. Install venturi cluster in carburetor as shown.

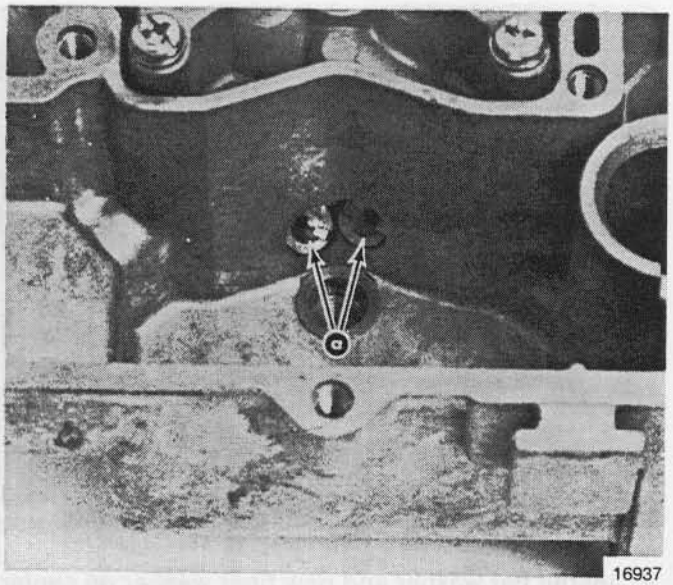

26582

4. Install flat washer and new fiber washer on center screw (a). Lockwashers and flat washers are used on outer screws (b). Tighten screws evenly and securely.

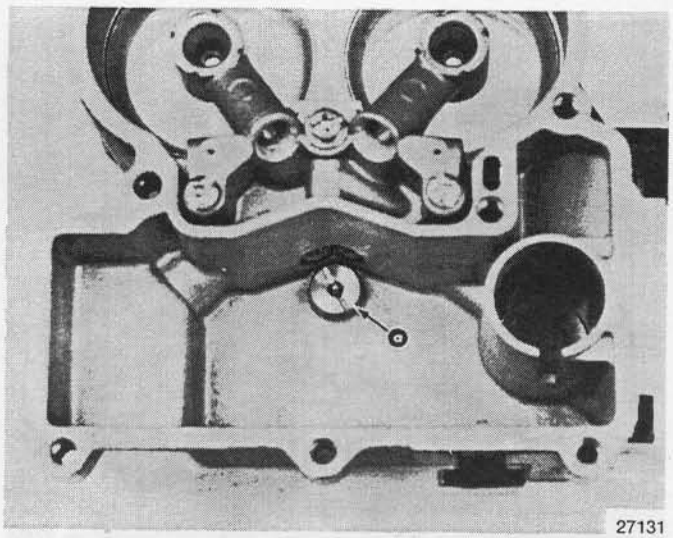


27458

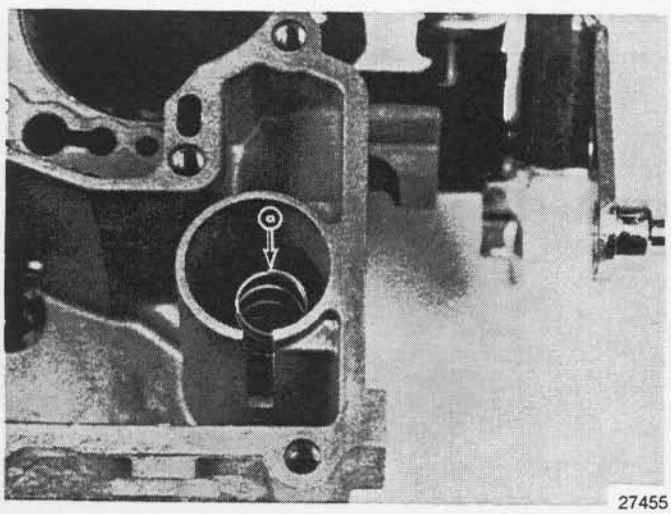
5. Install jets (a) as shown. Tighten securely.



6. Install power valve with new gasket (a). Tighten securely.



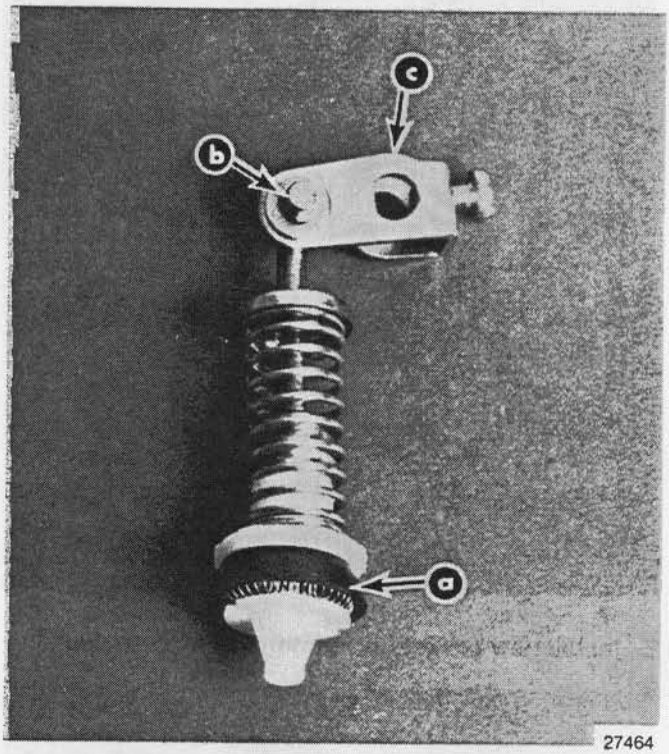
7. Place accelerator pump return spring (a) in pump well.



AIR HORN ASSEMBLY

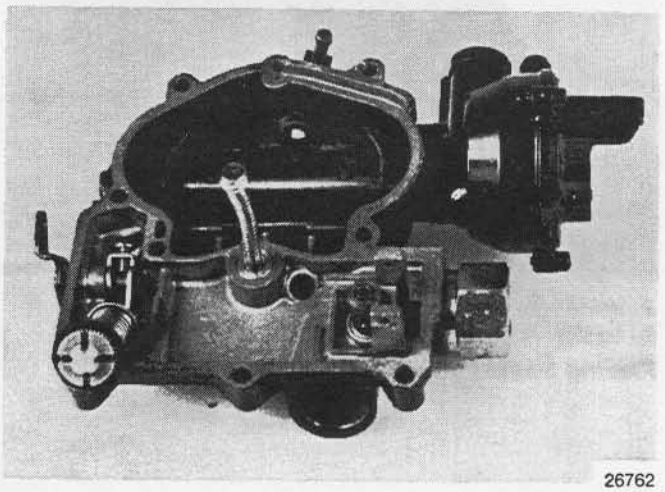
IMPORTANT: Accelerator pump assembly MUST BE installed correctly. If pump assembly is installed incorrectly, top of pump assembly will contact air horn casting.

1. If accelerator pump assembly was removed from pump lever, secure pump assembly to pump lever with washer and retainer clip, as shown.

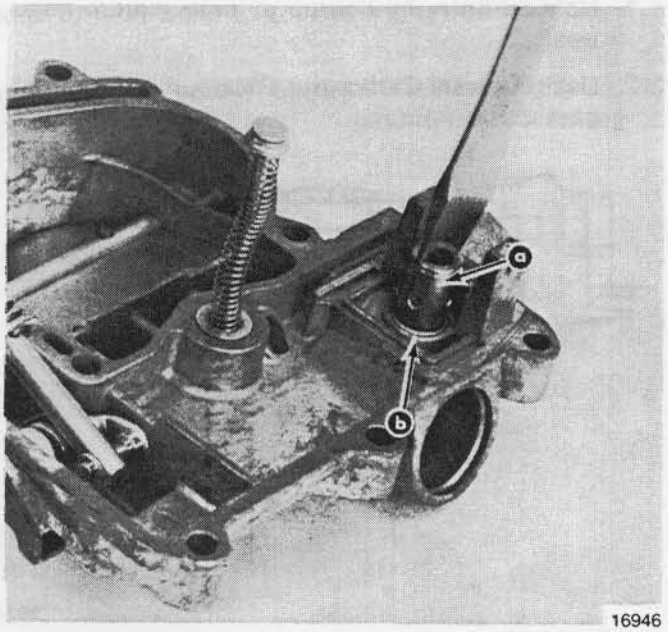


a - Accelerator Pump Assembly
b - Retainer Cup and Washer
c - Lever Assembly

2. Insert pump shaft and lever assembly (and washer) into air horn; then, align indexed hole in pump lever with shaft and lever assembly and slide shaft all-the-way into lever so that shoulder on shaft is hitting lever. Tighten set screw securely.



3. Install needle seat and gasket. Tighten securely.



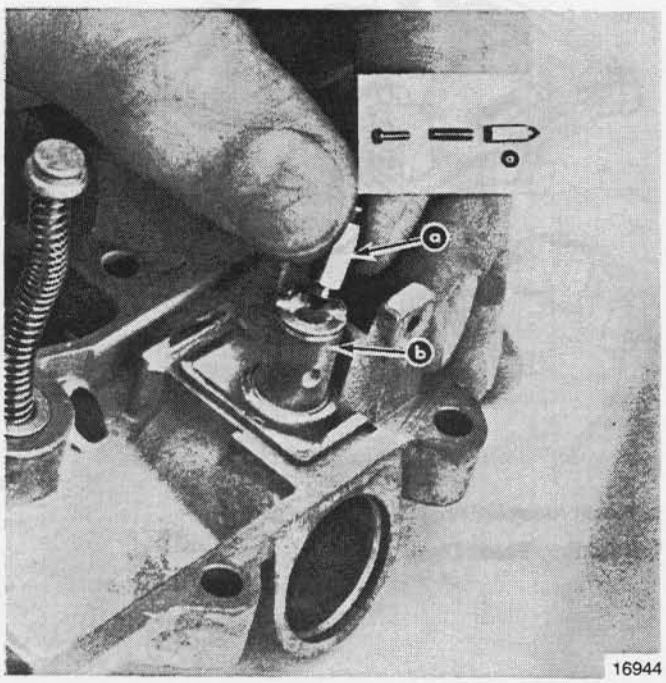
16946

a - Needle Seat
b - Gasket

Installing Needle Seat and Gasket

IMPORTANT: Float needle and needle seat are factory matched and tested and should be replaced as a set only.

4. Place needle assembly in needle seat.

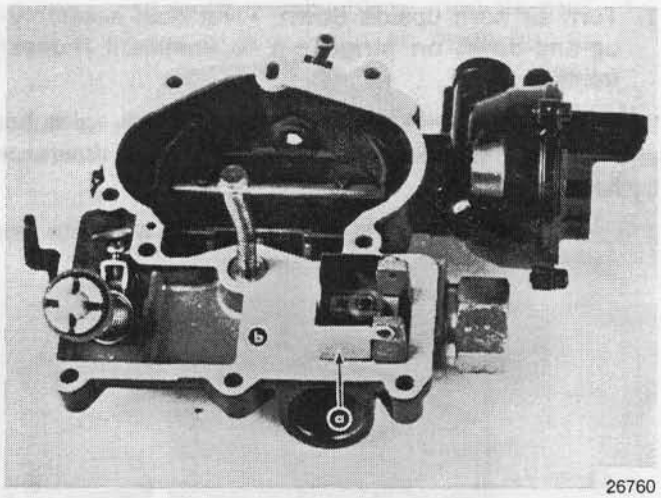


16944

a - Needle Assembly
b - Needle Seat

Installing Needle Assembly

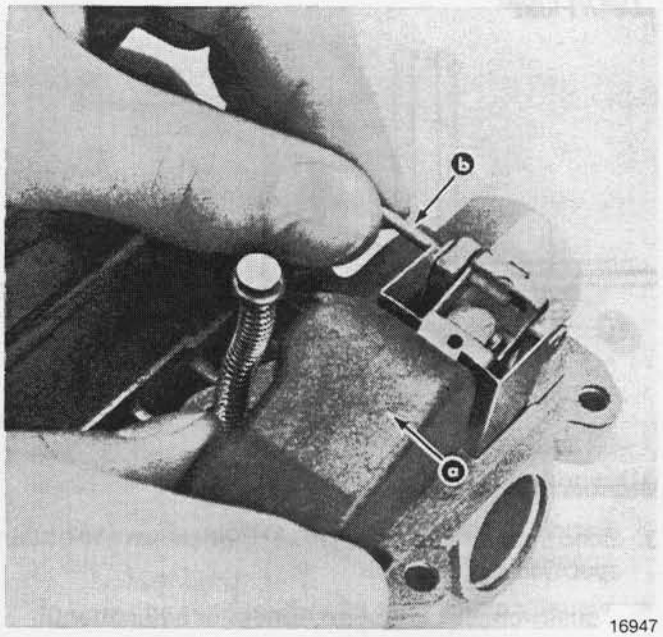
5. Install baffle (a) and gasket (b).



26760

a - Baffle
b - Gasket

6. Install float assembly and hinge pin. Pivot float assembly up-and-down on hinge pin to ensure it moves freely.



16947

a - Float Assembly
b - Float Hinge Pin

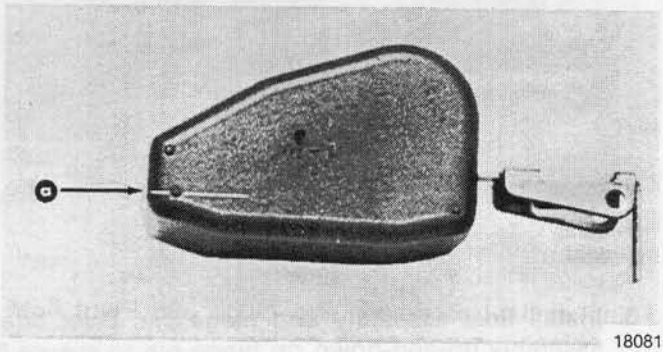
Installing Float Assembly Hinge Pin

FLOAT LEVEL

1. Turn air horn upside down. Pivot float assembly up-and-down on hinge pin to ensure it moves freely.

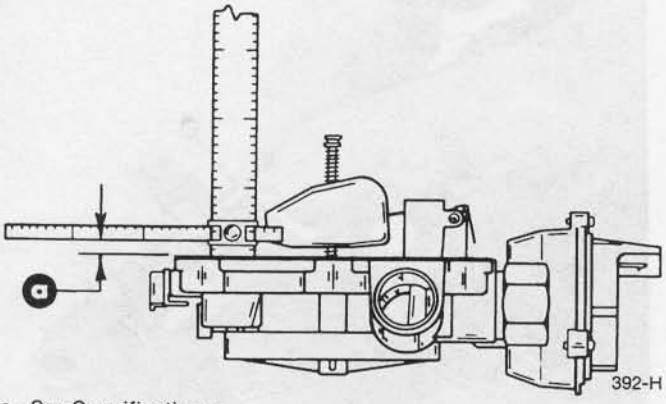
IMPORTANT: Before checking float level, raise float and allow it to fall; however, DO NOT force downward by hand.

2. Using Universal Carburetor Gauge, measure from gasket to toe of float.



a - Measure from This Point to Gasket

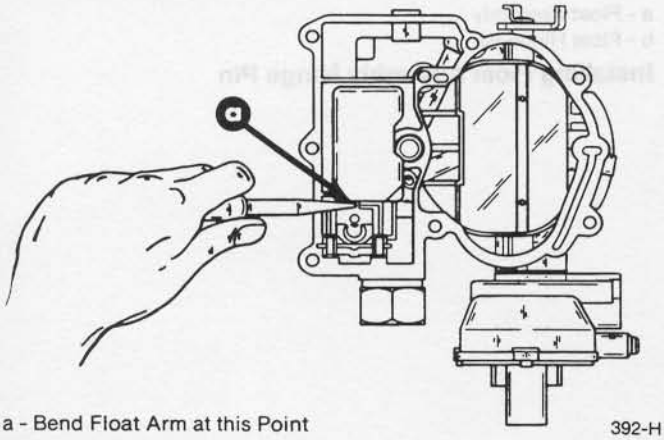
Toe of Float



a - See Specifications

Measuring Float Level

3. Bend float arm up or down at point shown to obtain specified dimension.
4. Visually check float alignment after adjustment.

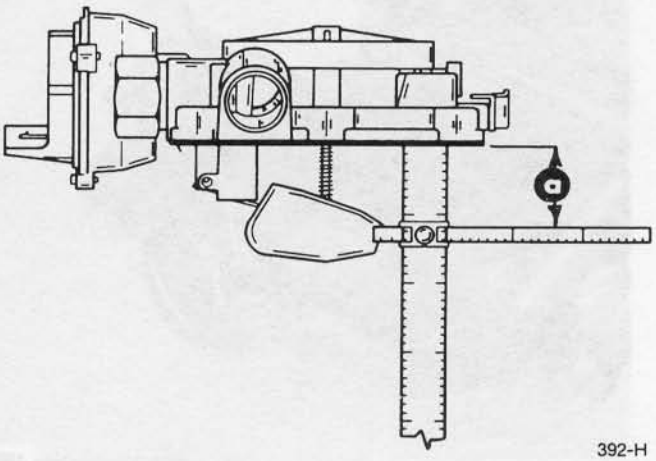


a - Bend Float Arm at this Point

Adjusting Float Level

FLOAT DROP

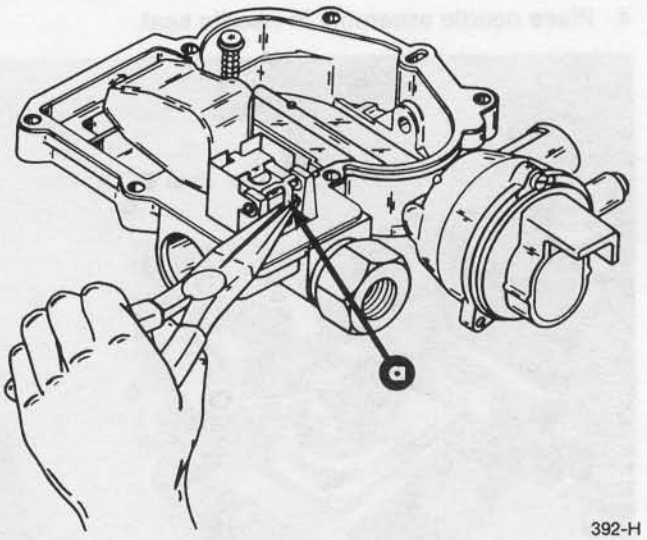
1. Hold air horn right-side-up to allow float to hand free.
2. Using Universal Carburetor Gauge, measure from gasket to toe of float.



a - See Specifications

Measuring Float Drop

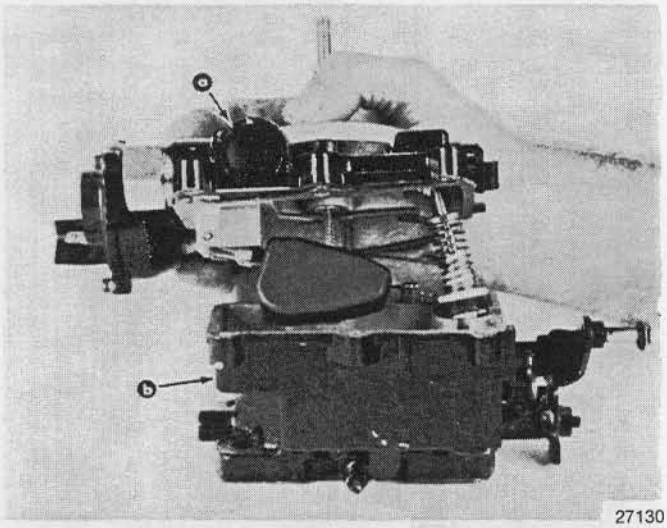
3. Bend float assembly tang, as shown to obtain specified dimension.
4. Recheck BOTH float level and float drop.



a - Float Assembly Tang

Adjusting Float Drop

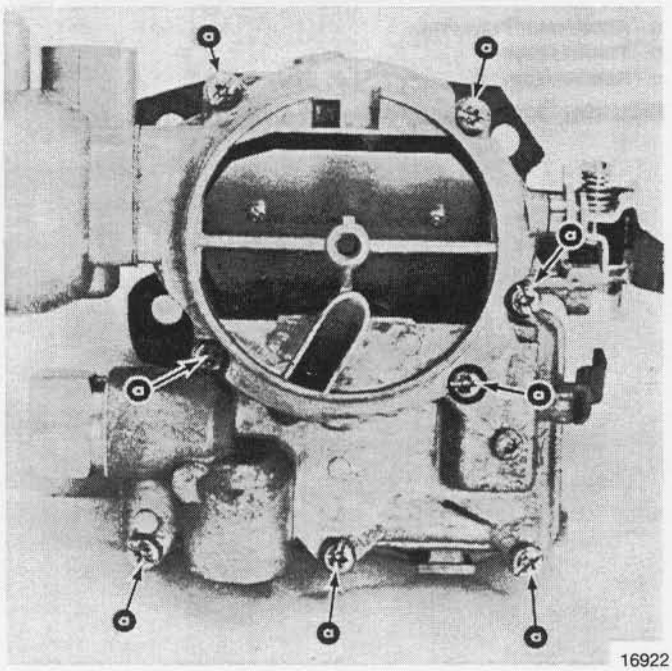
5. Place air horn on float bowl, making sure accelerator pump is correctly positioned in fuel well. Lower air horn straight down to install.



a - Air Horn
b - Float Bowl Assembly

Carefully Installing Air Horn

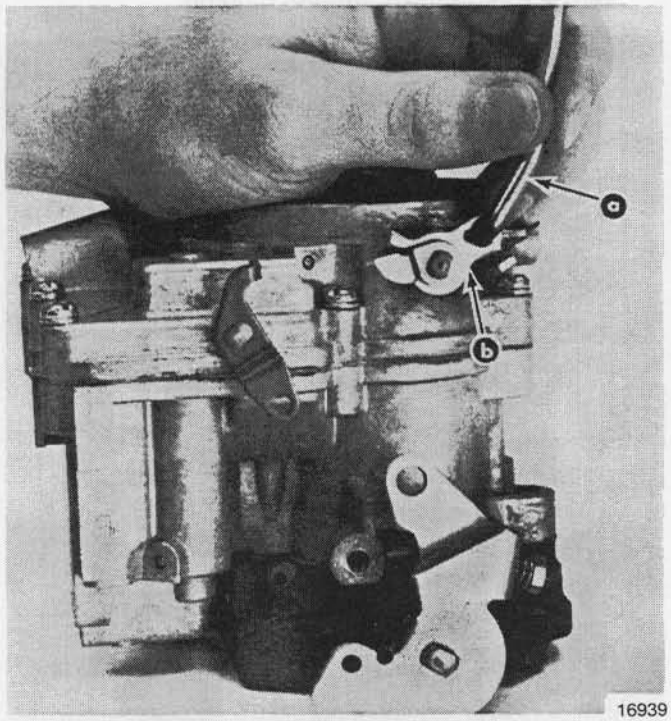
6. Install seven short and one long air horn attaching screws. Tighten screws evenly and securely.



a - Seven Short Screws
b - One Long Screw

Installing Air Horn Attaching Screws

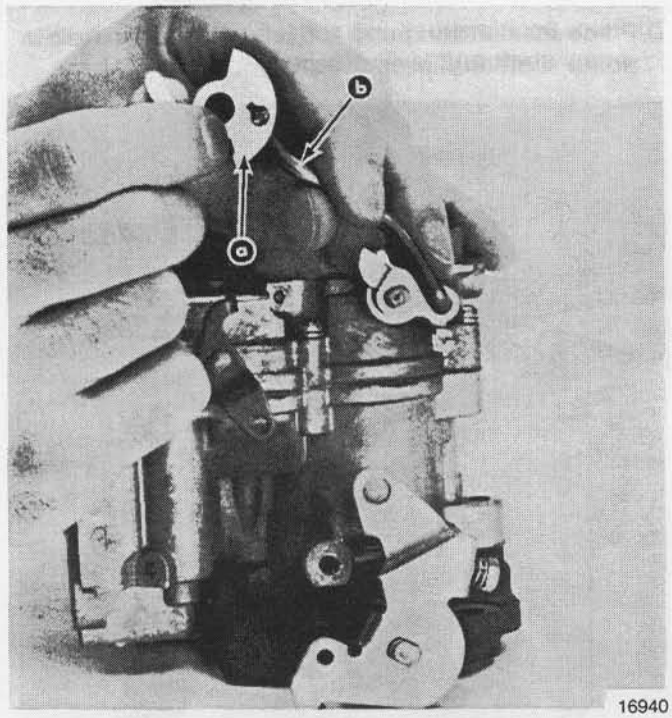
7. Place end of choke rod in choke lever and collar assembly.



a - Choke Rod
b - Choke Lever and Collar Assembly

Installing Choke Rod

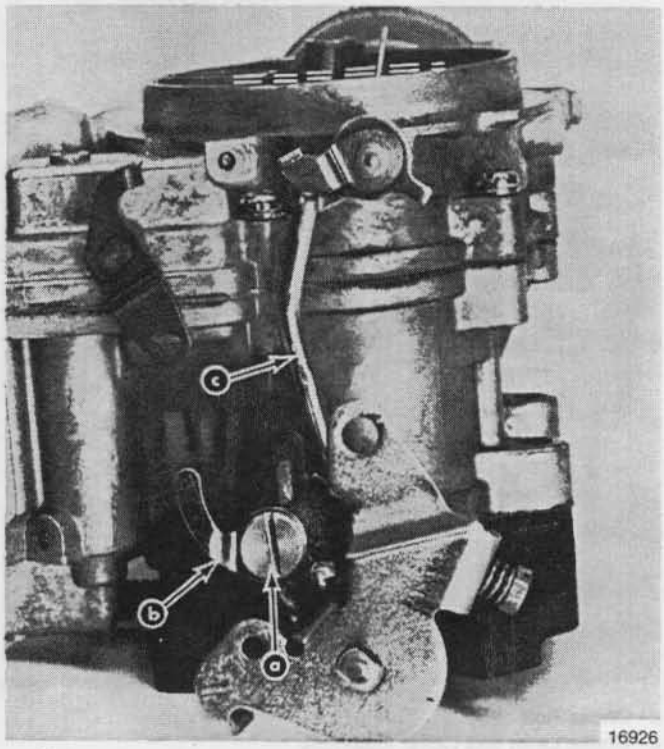
8. Place idle cam on choke rod.



a - Idle Cam
b - Choke Rod

Installing Idle Cam

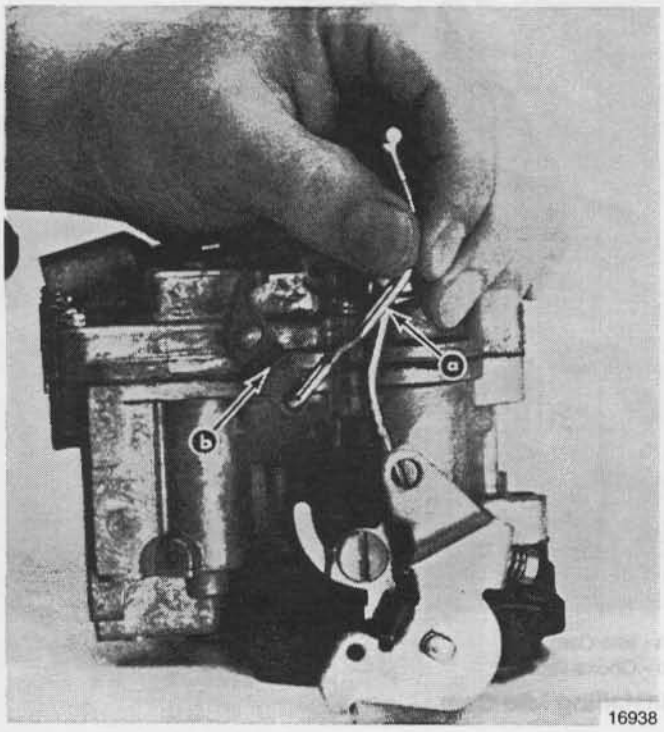
9. Secure idle cam (with choke rod installed on cam) on float bowl assembly, using screw. Check that cam is free to move without binding.



a - Screw
b - Idle Cam
c - Choke Rod

Securing Idle Cam to Float Bowl Assembly

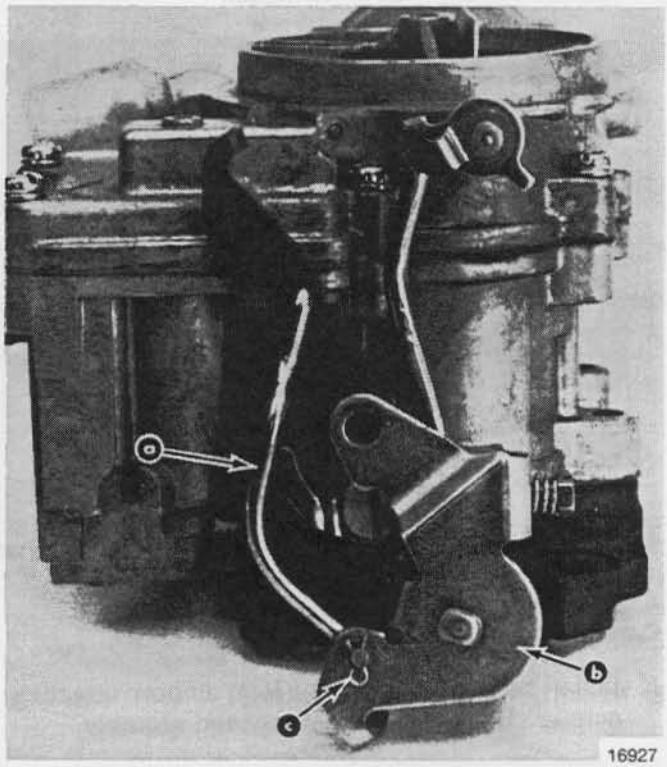
10. Place accelerator pump rod (end with ear) in hole in pump shaft and lever assembly.



a - Accelerator Pump Rod
b - Pump Shaft and Lever Assembly

Installing Accelerator Pump Rod

11. Insert remaining end of accelerator pump rod into hole in throttle lever and secure with retainer clip.



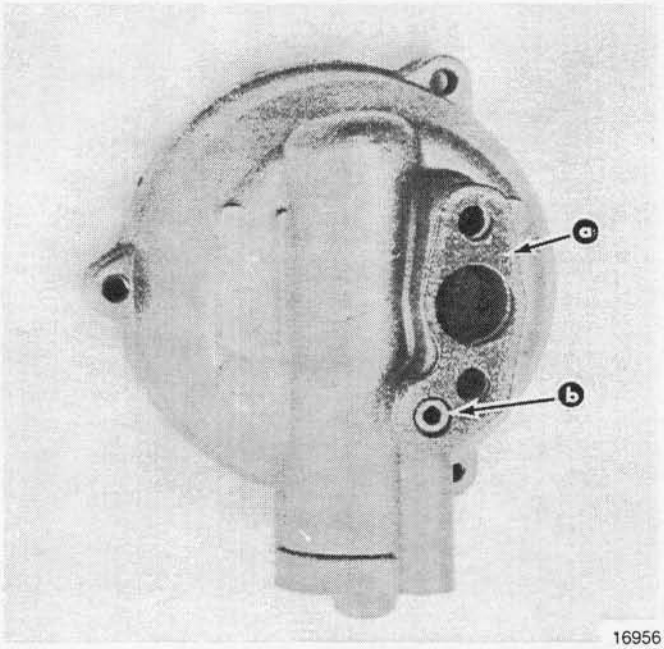
a - Accelerator Pump Rod
b - Throttle Lever
c - Retainer Clip

Securing Accelerator Pump Rod to Throttle Lever

CHOKE HOUSING ASSEMBLY

IMPORTANT: Not all MerCarb carburetors are equipped with choke housing gasket. This gasket is not necessary for choke housing installation; therefore, if replacement gasket is not available, choke housing may be installed on air horn assembly without gasket.

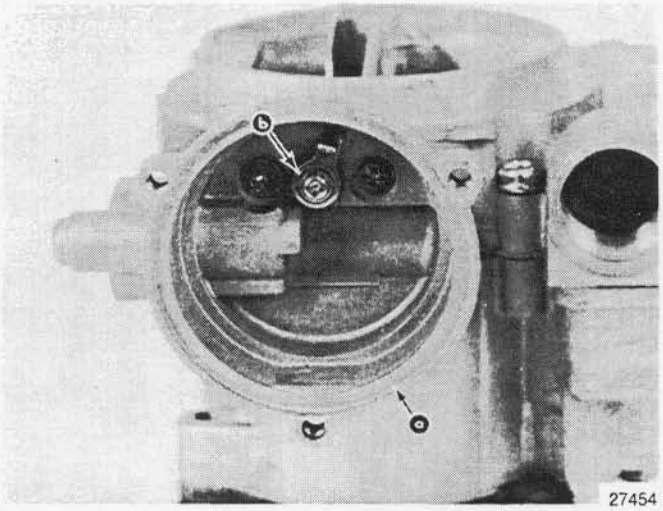
1. Place new choke housing gasket (if equipped) in position on air horn making sure that, when installing choke housing assembly, locating pin on housing inserts into hole in gasket.



16956

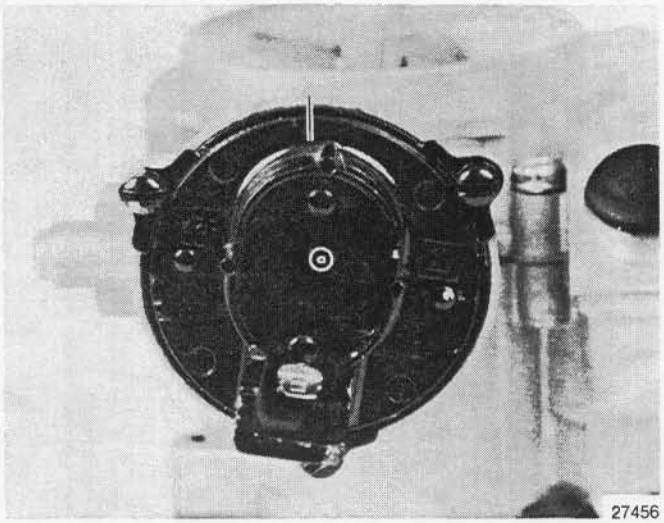
a - Gasket
b - Choke Housing Assembly Gasket Locating Pin

2. Install choke housing (a) on air horn. Tighten screws securely. Install choke lever (b). Tighten screw securely.

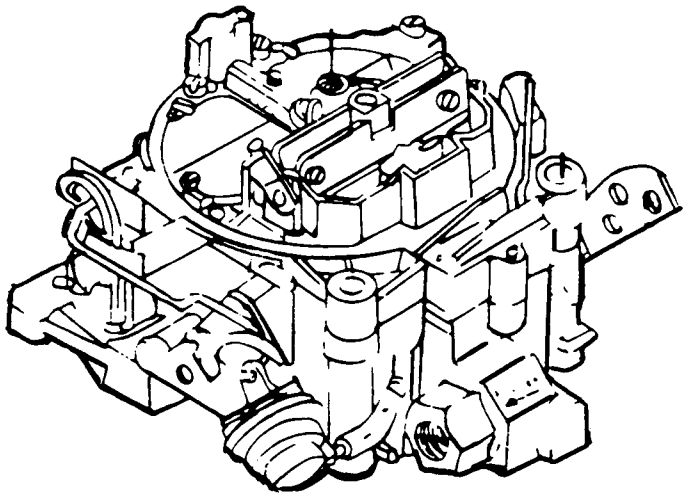


27454

3. Install choke cover (a). Make sure hook on end of choke coil engages with choke lever. Rotate choke cover until index marks align as shown. Tighten screws securely.


27456

FUEL SYSTEM



ROCHESTER 4 BARREL

5

C

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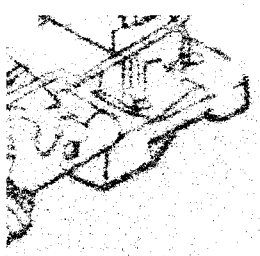
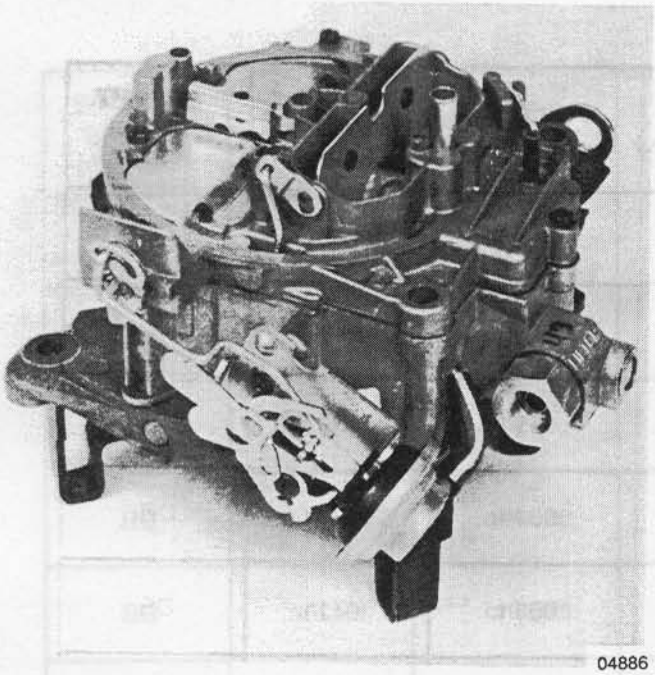
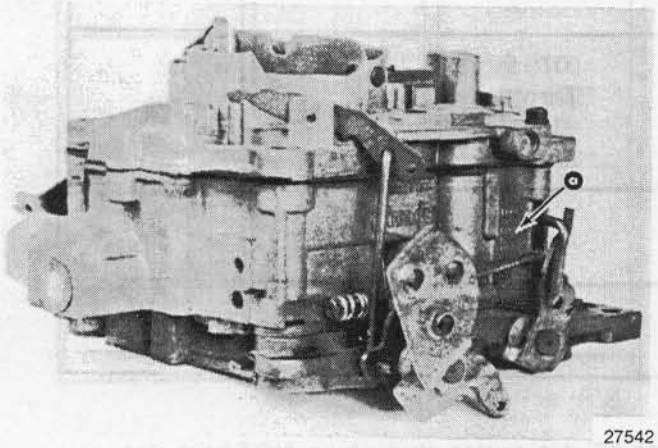


ROCHESTER

Identification



04886



27542

a - G.M. Identification Number

Replacement Parts Warning

⚠WARNING

Electrical, ignition and fuel system components on your MerCruiser are designed and manufactured to comply with U.S. Coast Guard Rules and Regulations to minimize risks of fire and explosion.

Use of replacement electrical, ignition or fuel system components, which do not comply with these rules and regulations, could result in a fire or explosion hazard and should be avoided.

Torque Specifications

Fastener Location	Lb. Ft. (N.m)	Lb. In. (N.m)
Carburetor to Manifold		132 (15)
Fuel Line To Carburetor	18 (24)	
Fuel Inlet Filter Nut	18 (24)	

Tools

MERCURY MARINE SPECIAL TOOLS	
91-36392	Universal Carburetor Gauge
91-59339	Tachometer

KENT-MOORE TOOL GROUP 1600 EXECUTIVE DRIVE JACKSON, MICHIGAN 49203 TEL. (517) 788-6210	
J9789-118	Carburetor Stand
J22769	Needle Valve Seat Remover

WAGNER INSTRUMENTS P.O. BOX 1217 GREENWICH, CT. 06836 (203) 869-9681	
Model G.D. 150	Gram Scale (With Round Tip)

BORROUGHS TOOL & EQUIPMENT CORP. 2429 N. BURDICK ST. KALAMAZOO, MICH, 49007 (616) 345-5163	
BT-8128 B	Float Scale
BT-8420 A	Float Level Gauge

TORX® SCREWDRIVERS

Later Rochester Quadrajet carburetors will have a "star" shaped socket in the head of the screw. A TORX® screwdriver must be used on this type of screw. The three sizes used are #9, #20, and #25.

MCM Carburetor Specifications

Model (Serial Number)	Carb Type (Note 1)	Mercury No. (Manufacturer No.)	Primary Jet Size	Primary Metering Rods	Secondary Metering Rods
MCM 5.0 Litre LX	Rochester 4MV	1347-9661 (17080565)	.069 In.	.042 In.	CL
MCM 5.7 Litre	Rochester 4MV	1347-9662 (17080561)	.068 In.	.041 In.	CL
MCM 350 Magnum	Rochester 4MV	1347-8289 (17080562)	.069 In.	.036 In.	CH
MCM 7.4 Litre	Rochester 4MV	1347-8291 (17080563)	.069 In.	.042 In.	DB
MCM 454 Magnum (Alpha)	Rochester 4MV	1347-8291 (17080563)	.069 In.	.042 In.	DB
MCM 454 Magnum (Bravo)	Rochester 4MV	1347-9863 (17059280)	.068 In.	.041 In.	DA
MCM 502 Magnum (Bravo)	Rochester 4MV	1347-814623 (17089112)	.070 In. Throttle .076 In. Choke	.044 In.	DC
MCM 5.7 Litre	Rochester 4MV	1347-816373 (17090210)	.068 In.	.040 In.	DA
MCM 7.4 Litre	Rochester 4MV	1347-816467 (17090211)	.069 In.	.042 In.	DA

NOTES:
1. Rochester Quadrajets are 4MV or 4MC type. The "V" or "C" designates choke type, NOT bore size.

MIE Carburetor Specifications

Model (Serial Number)	Carb Type (Note 1)	Mercury No. (Manufacturer No.)	Primary Jet Size	Primary Metering Rods	Secondary Metering Rods
MIE 5.0 Litre	Rochester 4MV	1347-9661 (17080565)	.069 In.	.042 In.	CL
MIE 5.7 Litre	Rochester 4MV	1347-8289 (17080562)	.069 In.	.036 In.	CH
MIE 5.7 Ski	Rochester 4MV	1347-9415 (17085013)	.069 In.	.042 In.	CH
MIE 7.4 Litre	Rochester 4MV	1347-8288 (17080560)	.069 In.	.042 In.	CL
MIE 8.2 Litre	Rochester 4MV	1347-814623 (17089112)	.070 In. Throttle Lever Side .076 In. Choke Lever Side	.044 In.	DC
MIE 5.7 Litre	Rochester 4MV	1347-816373 (17090210)	.068 In.	.040 In.	DA
MIE 7.4 Litre	Rochester 4MV	1347-816467 (17090211)	.069 In.	.042 In.	DA

NOTES:
1. Rochester Quadrajets are 4MV or 4MC type. The "V" or "C" designates choke type, NOT bore size.

UNIT OF MEASUREMENT in. (mm)

MCM Carburetor Adjustment Specifications (Note 1)

Engine Model	5.0Litre LX	5.7 Litre	350 Magnum	7.4 Litre	454 Magnum	8.2 Litre 502 Magnum
Make & Model	Rochester 4MV					
Carb. Manufacturer Number	17080565	17080561	17080562	17080563	17059280	17089112
Float Level	15/64 (5.9)					
Pump Rod Hole Location	Inner					
Accelerator Pump (Note 2)	23/64 (9.1)					
Air Valve Dash Pot (Air Valve Rod)	.025 (.64)					
Vacuum Break	.080 [5/64 (2.0)]					.190 [3/16 (4.76)]
Air Valve Spring Wind Up	70-90 GR.	70-90 GR.	70-90 GR.	70-90 GR.	70-90 GR.	80 GR.
Choke Coil Rod (Note 3)	Top of Rod Even With Bottom of Hole					
Idle Mixture Screw Preliminary Setting	2-3 Turns					
Float Weight (Max)	8.3 GR.					8.3 GR.

NOTES: 1. All measurements are ± 1/64 in. (0.4mm).

2. Accelerator pump measurement taken from flame arrestor surface to pump stem with throttle plates closed.
3. Choke valve must be closed, choke rod in bottom of choke lever slot, and choke coil rod pushed down to end of travel.

UNIT OF MEASUREMENT in. (mm)

MIE Carburetor Adjustment Specifications (Note 1)

Engine Model	5.0 Litre	5.7 Comp Ski	5.7 Litre	7.4 Litre	8.2 Litre
Make & Model	Rochester 4MV				
Carb. Manufacturer Number	17080565	17085013	17080562 17090210	17080560 17090211	17089112
Float Level	15/64 (5.9)				
Pump Rod Hole Location	Inner				
Accelerator Pump (Note 2)	23/64 (9.1)				
Air Valve Dash Pot (Air Valve Rod)	.025 (.64)				
Vacuum Break	.080 [5/64 (2.0)]				.190 [3/16 (4.76)]
Air Valve Spring Wind Up	70-90 GR.	75-85 Gr.	70-90 Gr.	80-95 Gr.	80 Gr.
Choke Coil Rod (Note 3)	Top of Rod Even With Bottom of Hole				
Idle Mixture Screw Preliminary Setting	2-3 Turns				
Float Weight (Max)	8.3 GR.				8.3 Gr.

NOTES: 1. All measurements are ± 1/64 in. (0.4mm).

2. Accelerator pump measurement taken from flame arrestor surface to pump stem with throttle plates closed.
3. Choke valve must be closed, choke rod in bottom of choke lever slot, and choke coil rod pushed down to end of travel.

Description

The Quadrajet carburetor has 2 stages in operation. The primary (fuel inlet) side has small bores with a triple venturi set-up equipped with plain tube nozzles. Its metering principles are similar to the most plain tube carburetors which use the venturi principle. The triple venturi stack up, plus smaller primary bores, give a more stable and finer fuel control in idle and economy ranges of operation. Fuel metering in primary side is accomplished with tapered metering rods positioned by a manifold vacuum responsive piston.

Secondary side has 2 very large bores which have greatly increased air capacity to meet present day and future engine demands. Air valve principle is used in secondary side for metering control and supplements fuel flow from primary bores.

Using air valve principle, fuel is metered in direct proportion to air passing thru secondary bores.

Fuel reservoir is centrally located to avoid problems of fuel slosh causing engine turn cut-out and delayed fuel to carburetor bores. Float system uses a single float pontoon for ease in servicing the unit.

Precautions

⚠WARNING
Always disconnect battery cables from battery BEFORE working on fuel system to prevent fire or explosion.

⚠WARNING
Be careful when cleaning flame arrestor and crankcase ventilation hose; gasoline is extremely flammable and highly explosive under certain conditions. Be sure that ignition key is "OFF". DO NOT smoke or allow sources of spark or open flame in area when cleaning flame arrestor and crankcase ventilation hose.

⚠WARNING
Be careful when changing fuel system components; gasoline is extremely flammable and highly explosive under certain conditions. Be sure that ignition key is "OFF". DO NOT smoke or allow sources of spark or flame in the area while changing fuel filter. Wipe up any spilled fuel immediately.

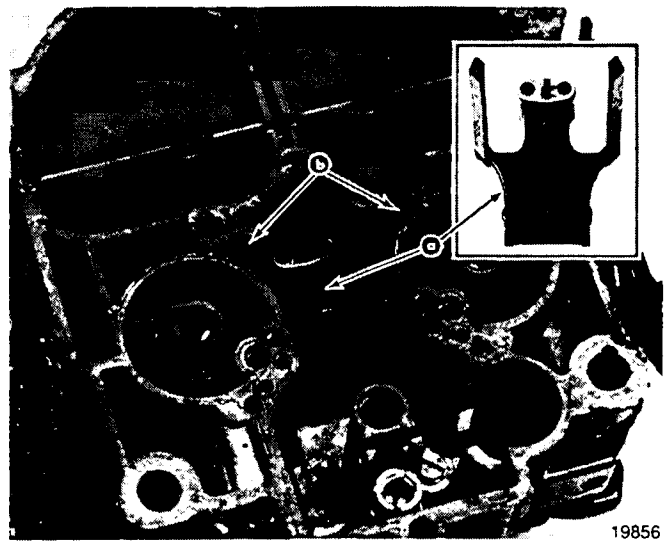
⚠WARNING
Make sure no fuel leaks exist, before closing engine hatch.

⚠CAUTION
DO NOT operate engine without cooling water being supplied to water pickup holes in gear housing, or water pump impeller will be damaged and subsequent overheating damage to engine may result.

Important Service Information

NOZZLE DEFLECTOR, MIE 5.0/5.7/7.4 LITRE INBOARD NAD V-DRIVE

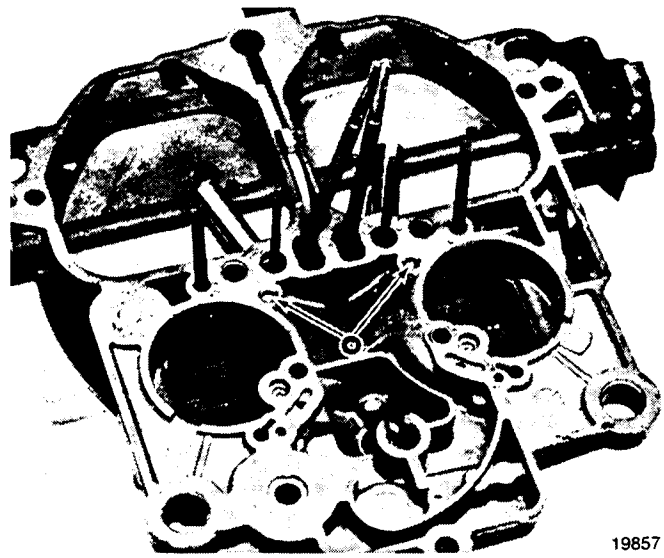
If you receive a complaint of high speed surging on a MIE engine equipped with a Quadrajet carburetor, the problem can be cured by installing a nozzle deflector (P/N 1397-9422) as shown.



19856

a - Nozzle Deflector
b - Locating Bosses

When installing the nozzle deflector, inspect the air horn for the 2 locating holes as shown. If the locating holes are in the air horn, the nozzle deflector can be installed as is. If the air horn does not have these locating holes, the 2 bosses on the nozzle deflector must be carefully removed so the air horn will fit flush on the float bowl.


19857

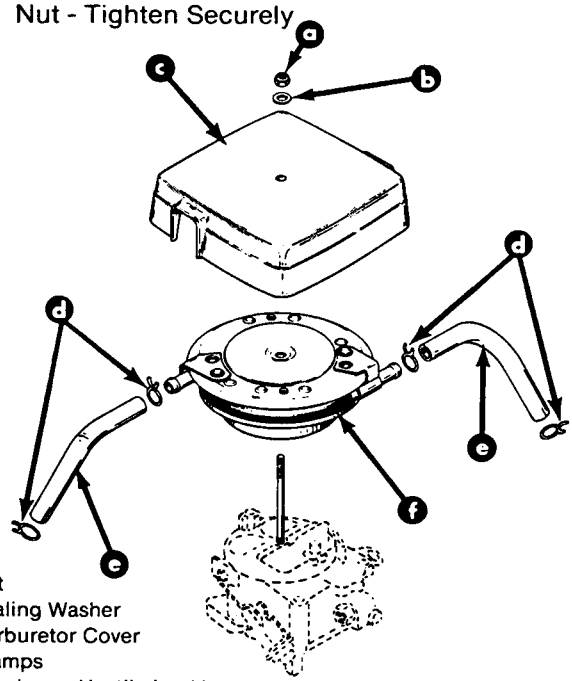
a - Locating Holes

Maintenance

Flame Arrestor

NOTICE
Refer to "Precautions" in this section BEFORE proceeding.

1. Remove (in the following order):
   a. Nut
   b. Sealing Washer
   c. Carburetor Cover
   d. Crankcase Ventilation Hoses - From Flame Arrestor and Rocker Arm Covers
   e. Flame Arrestor
2. Clean and Inspect:
   a. Clean flame arrestor in solvent and blow dry with compressed air.
   b. Clean crankcase ventilation hoses
   c. Inspect crankcase ventilation hose for cracks or deterioration, and replace if necessary.
3. Install (in the following order):
   a. Flame Arrestor
   b. Crankcase Ventilation Hose - To Flame Arrestor and Rocker Arm Covers
   c. Carburetor Cover
   d. Sealing Washer
   e. Nut - Tighten Securely



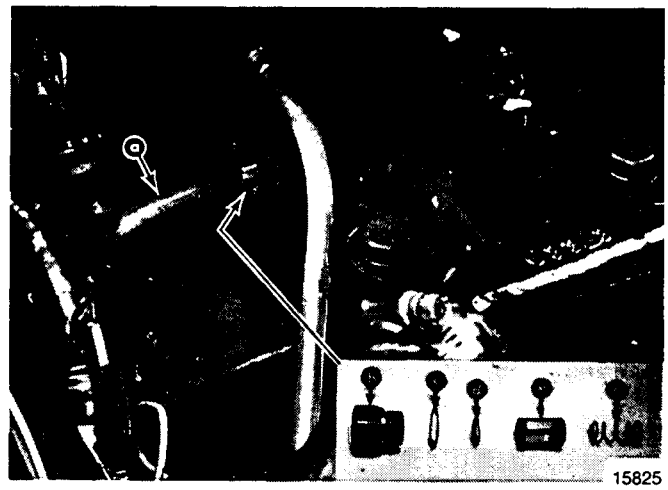
a - Nut
b - Sealing Washer
c - Carburetor Cover
d - Clamps
e - Crankcase Ventilation Hoses
f - Flame Arrestor

Flame Arrestor with Carburetor Cover (Typical)

Fuel Filter

NOTICE
Refer to "Precautions" in this section BEFORE proceeding.

1. Remove:
   - Fuel line from fuel inlet filter nut
   - Fuel inlet filter nut
   - Large gasket
   - Filter
   - Spring
   - Small gasket - From inside filter nut



a - Fuel Line
b - Fuel Inlet Filter Nut
c - Gasket (Large)
d - Gasket (Small)
e - Filter
f - Spring

Changing Fuel Filter

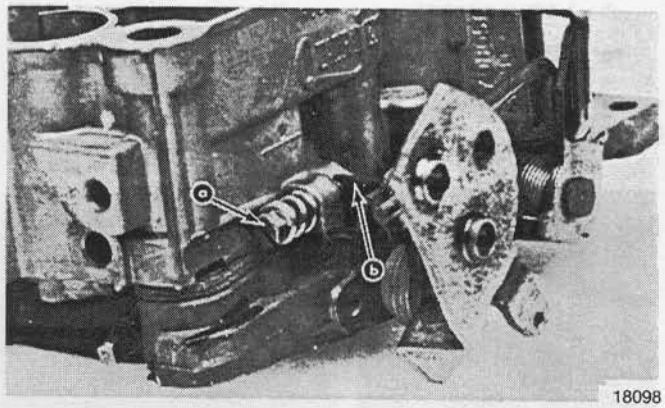
2. Clean filter nut and spring.
3. Install the following:
   - Spring - Place in carburetor body
   - Filter - Open end to inlet filter nut
   - Small gasket - Place inside filter nut
   - Large gasket - Place over filter nut
   - Fuel inlet filter nut - Tighten to 18 lb. ft. (24 N.m)
   - Fuel line - Tighten to 18 lb. ft. (24 N.m)

Adjustments

NOTICE
Refer to "Precautions" in this section BEFORE proceeding.

Accelerator Pump

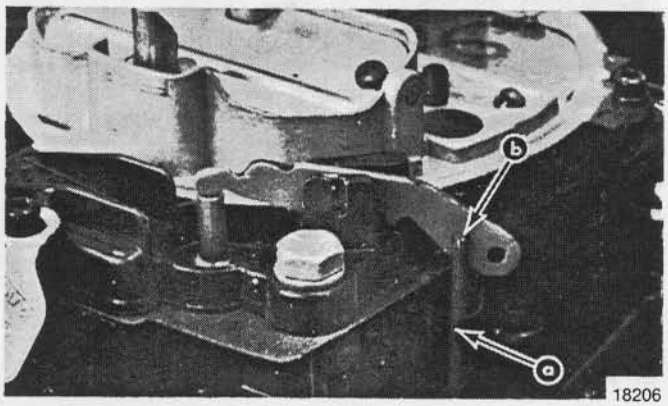
1. Back out idle stop screw until it no longer contacts throttle lever.



a - Idle Stop Screw
b - Throttle Lever

Backing Out Idle Stop Screw

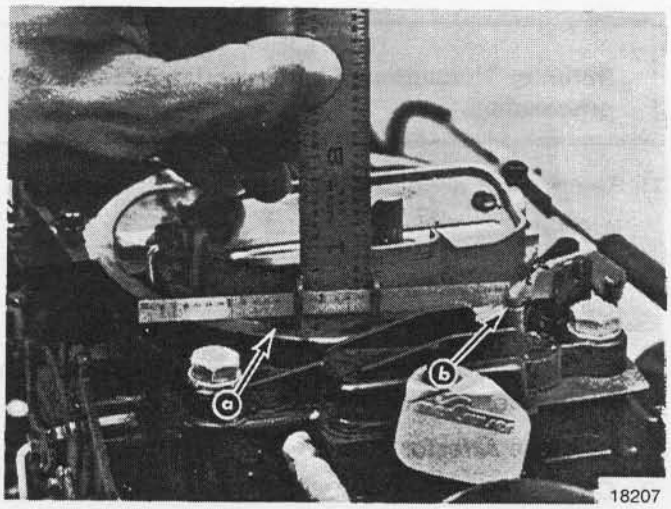
2. Pump rod must be in inner hole of lever.



a - Pump Rod
b - Inner Hole

Pump Rod Location

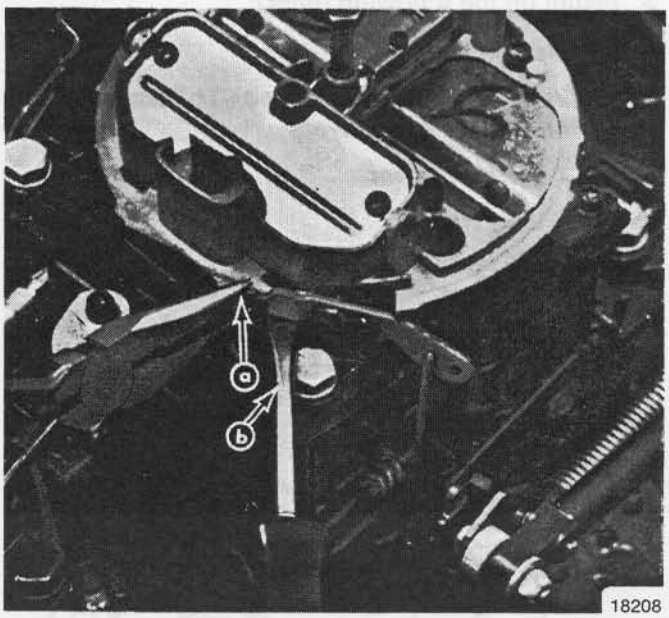
3. Close throttle valves completely and measure from flame arrestor mounting surface to top of pump plunger stem.



a - Flame Arrestor Mounting Surface
b - Pump Plunger Stem

Measuring Pump Plunger Height

4. While supporting lever, bend tip of pump lever to obtain specified dimension.

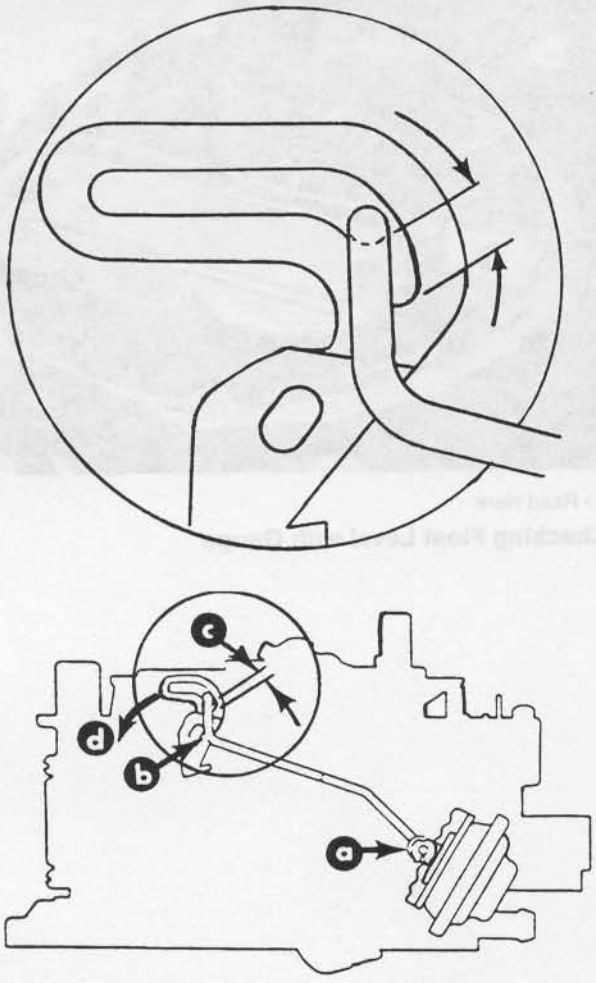


a - Tip of Pump Lever
b - Support as Shown

Adjusting Pump Plunger Height

Air Valve Dashpot

1. Seat vacuum break diaphragm and close air valve completely. Bend rod to adjust gap to specifications.

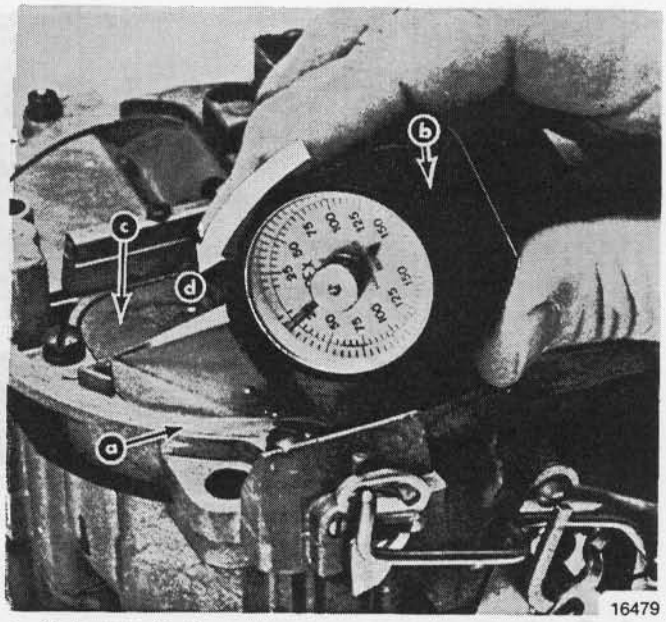


a - Push in Completely
b - Bend Here to Adjust
c - Specified Gap
d - Fully Closed

Adjusting Dashpot Link Rod

Air Valve Spring Windup

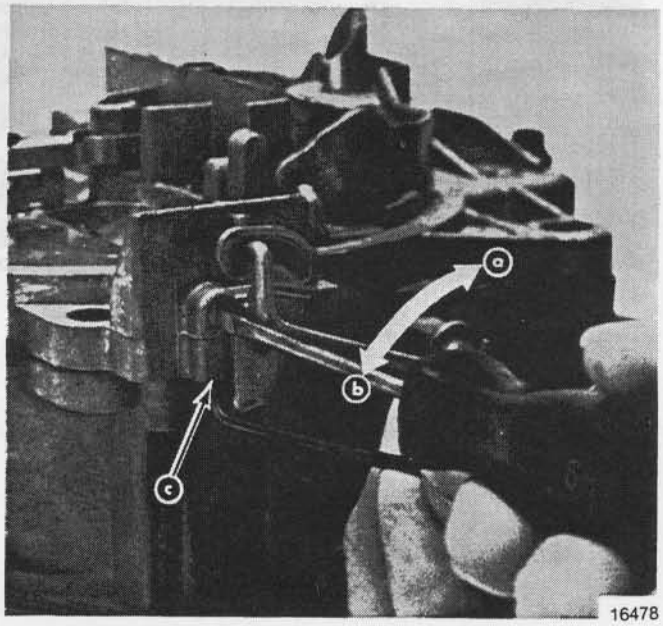
1. Rotate gram scale until air valve begins to open, check scale reading.



a - Carburetor Casting
b - Gram scale
c - Contact Area of Arm on Air Valve
d - Rotate

Checking Air Valve

2. To adjust spring windup, hold tension spring screw and loosen allen head screw.
3. Adjust tension and retighten allen screw securely.

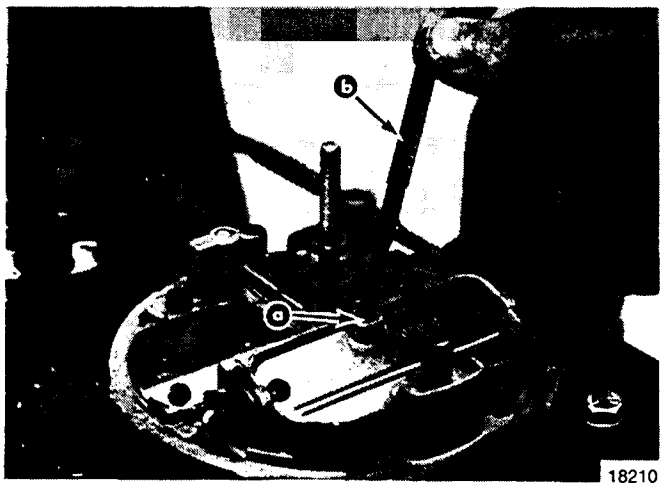


a - Increase
b - Decrease
c - Loosen Allen Head Screw

Adjusting Air Valve

Float Level

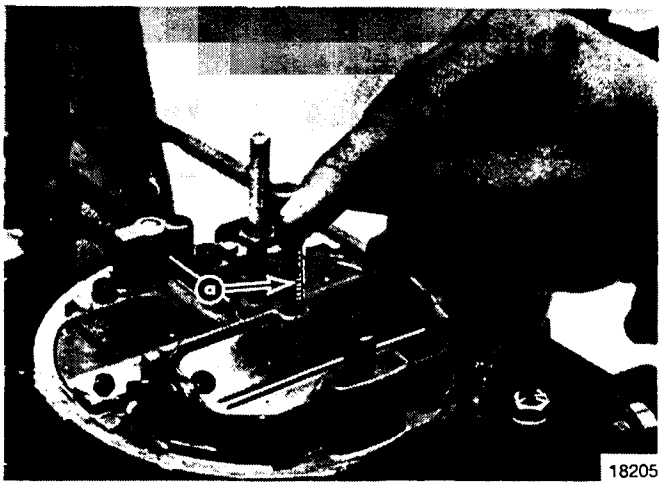
1. Start engine to fill float bowl, run at idle and insert float gauge into hole next to flame arrestor stud.



a - Gauge Hole
b - Gauge (BT-8420A)

Installing Float Gauge

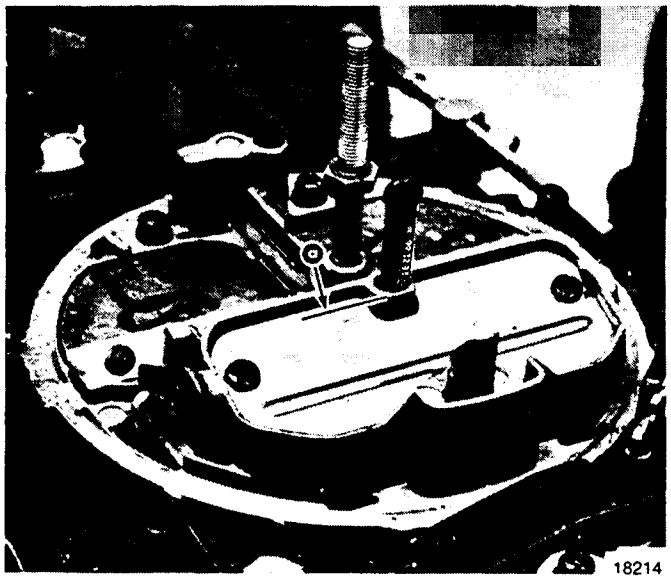
2. Tap float gauge down lightly to assure free movement.



a - Gauge

Tapping Float Gauge

3. Take gauge reading at top of carburetor casting.

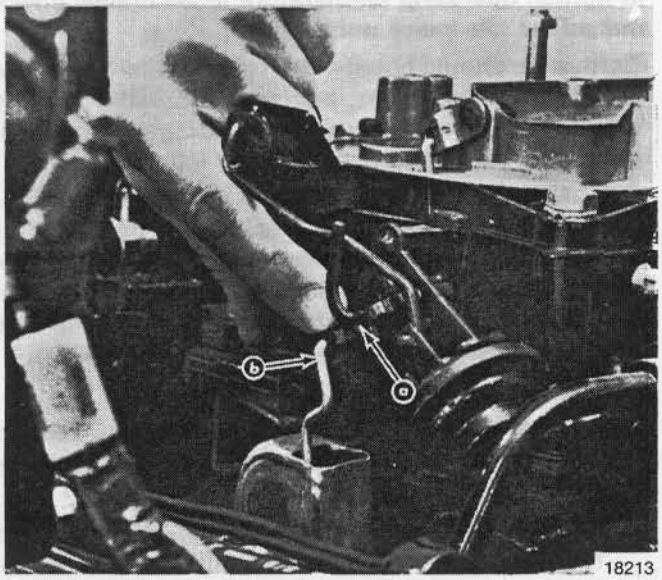


a - Read Here

Checking Float Level with Gauge

Choke Coil Rod

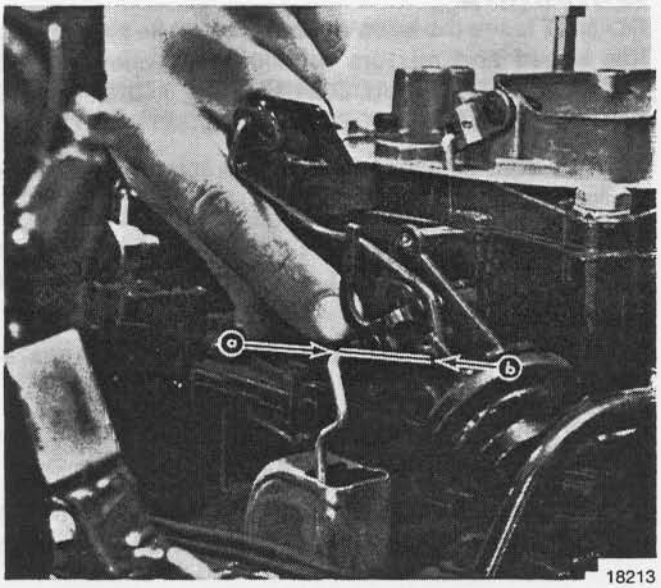
1. Push choke coil rod down.



a - Vacuum Break Choke Lever
b - Choke Coil Rod

Pushing Choke Rod Down

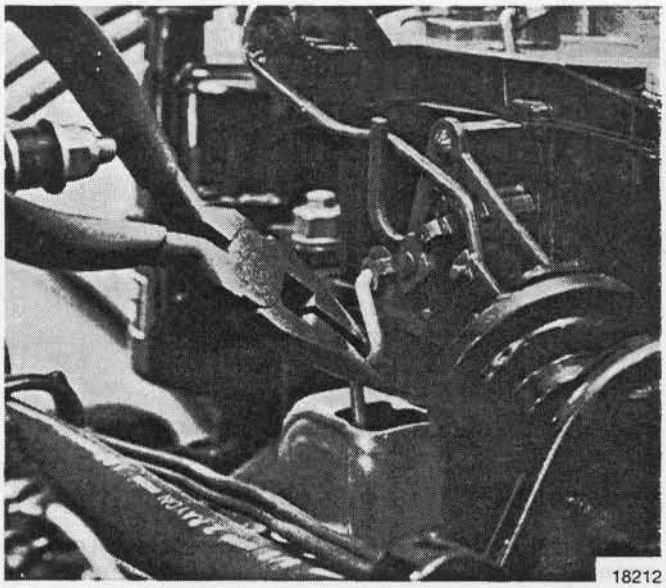
2. Choke coil rod top must be even with bottom of hole in vacuum break choke lever.



a - Top of Rod
b - Bottom of Hole

Checking Choke Rod Adjustment

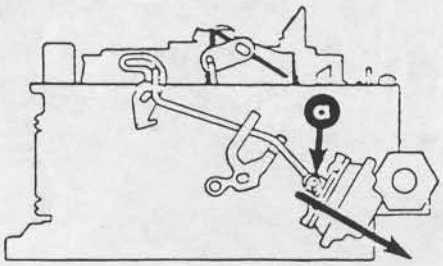
3. Bend rod to adjust.



Bending Choke Coil Rod

Vacuum Break

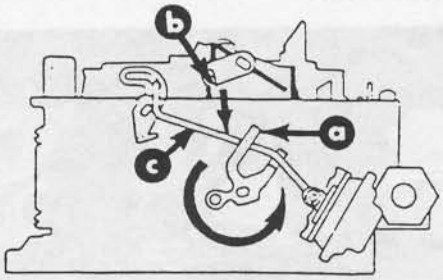
1. Seat vacuum break control diaphragm.



a - Vacuum Break Control Diaphragm

Seating Vacuum Break Control Diaphragm

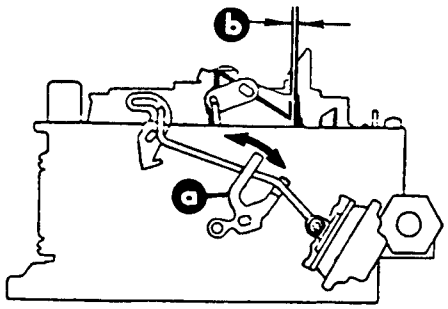
2. Rotate vacuum break choke lever counterclockwise until tang contacts vacuum break rod. Choke rod must be at bottom of choke shaft lever slot.



a - Tang
b - Choke Rod
c - Vacuum Break Rod

Rotating Choke Lever

3. Bend tang as necessary to obtain specified choke valve gap.



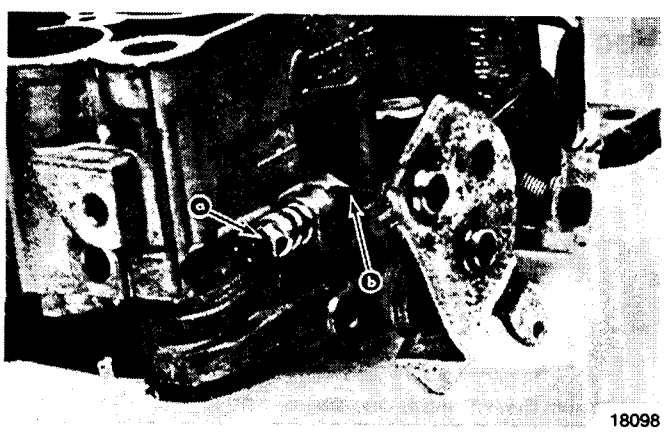
a - Tang
b - Specified Gap

Checking Vacuum Break and Unloader Adjustment

Preliminary Idle Speed and Mixture

Initial start setting, make final adjustments with engine running.

1. Turn idle stop screw until contact with throttle lever.

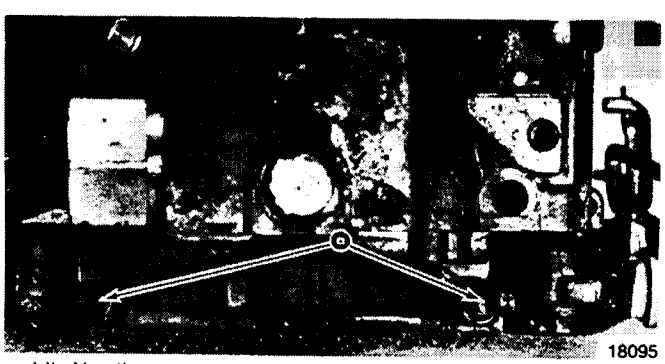


18098

a - Idle Stop Screw
b - Throttle Lever

Idle Stop Screw and Throttle

2. Turn idle needles until LIGHTLY seated then back out 2 to 3 turns.



18095

a - Idle Needles

Idle Mixture Needles

IMPORTANT: Do not turn idle mixture screws tightly against seat, as damage to seat and/or needle may result.

Final Idle Speed and Mixture

IMPORTANT: Boat MUST BE in the water and engine at normal operating temperature to accurately check and adjust idle speed and mixture.

Carburetor should be set so that engine idles smoothly, with boat in the water, engine at normal operating temperature and drive unit in forward gear. To adjust idle speed and mixture, proceed as follows:

IMPORTANT: DO NOT attempt to compensate for other engine problems (incorrect ignition timing, faulty ignition components, low compression, vacuum leaks, etc.) with carburetor adjustments. This will only cover the problem, which must be corrected if engine is to achieve maximum fuel economy and performance.

1. Connect a shop tachometer to engine.

IMPORTANT: DO NOT turn idle mixture needles tightly into seat, as damage to needle and/or seat may result.

2. If a new or rebuilt carburetor has been installed, turn each idle mixture needle until it LIGHTLY contacts seat, then back out 2 to 3 turns. This will provide a sufficient setting to allow starting the engine.

3. Start engine and run at 1500 RPM until engine reaches normal operating temperature.

⚠WARNING

DO NOT leave the helm unoccupied while performing idle speed and mixture adjustments, following. BE CAREFUL NOT TO ACCIDENTALLY ACCELERATE ENGINE WHILE PERFORMING ADJUSTMENTS.

4. With boat in open water, place remote control in forward gear, idle position.

5. Disconnect throttle cable brass barrel from anchor stud. BE SURE NOT TO LOSE SPACER ON ANCHOR STUD.

6. Adjust idle speed adjustment screw to obtain specified RPM.

7. With engine running at specified RPM, adjust idle mixture needles as follows:

   a. Turn idle mixture needle inward (clockwise) until the engine speed begins to drop due to lean mixture.

   b. Turn idle mixture screw outward (counterclockwise) until the speed begins to drop due to a rich mixture.

   c. Turn screw inward to a point between these two extremes to obtain maximum engine smoothness and RPM.

   d. Repeat procedure with other needle.

   e. Readjust idle speed adjusting screw, if necessary, to obtain specified RPM.

IMPORTANT: Refer to "Section 2" for throttle cable installation and adjustment.

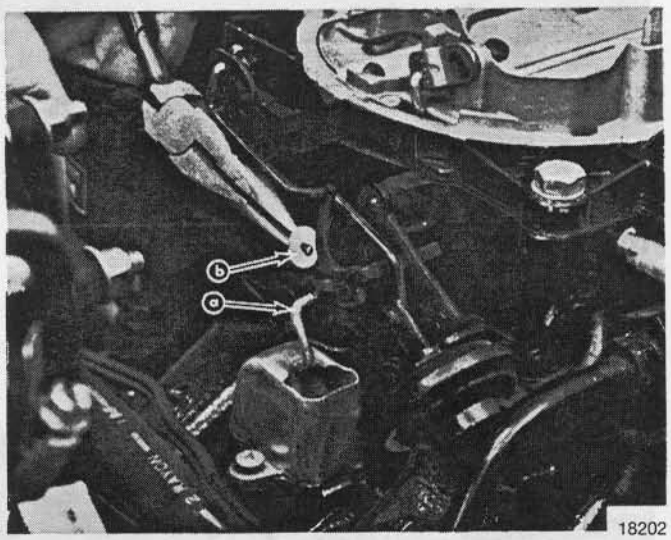
Repair

NOTICE
Refer to "Precautions" in this section BEFORE proceeding.

IMPORTANT: Carburetor malfunctions are, in many cases, caused by the presence of dirt, water or other foreign matter in carburetor. To aid in diagnosis, carefully remove carburetor from engine without draining fuel from bowl. Contents of fuel bowl may, then, be inspected for contamination as carburetor is disassembled.

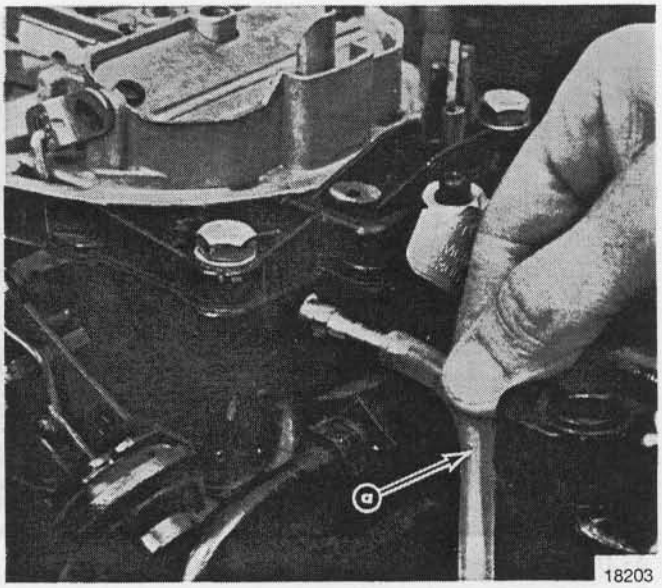
Removal

1. Remove flame arrestor.
2. Disconnect choke spring rod.



a - Choke Rod
b - Clip
Removing Choke Spring Rod

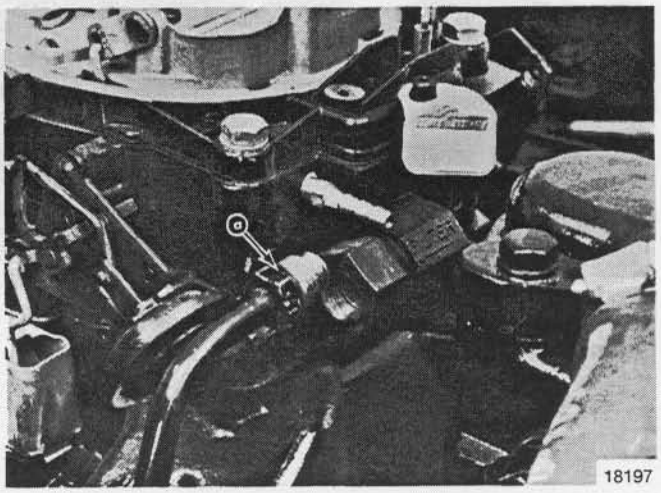
3. Disconnect sight tube (if equipped).



a - Sight Tube
Removing Sight Tube

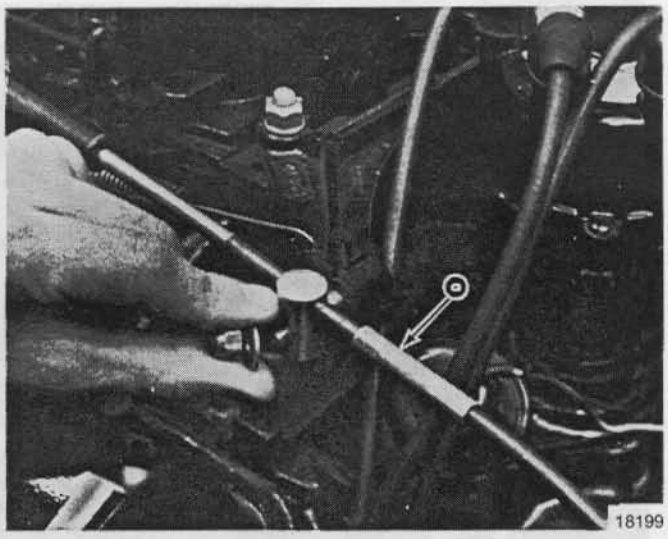
IMPORTANT: Place a clean cloth in bores of carburetor to prevent dirt and foreign material from falling into bores.

4. Turn off fuel supply at the fuel tank.
5. Disconnect fuel line.



a - Fuel Line
Removing Fuel Line

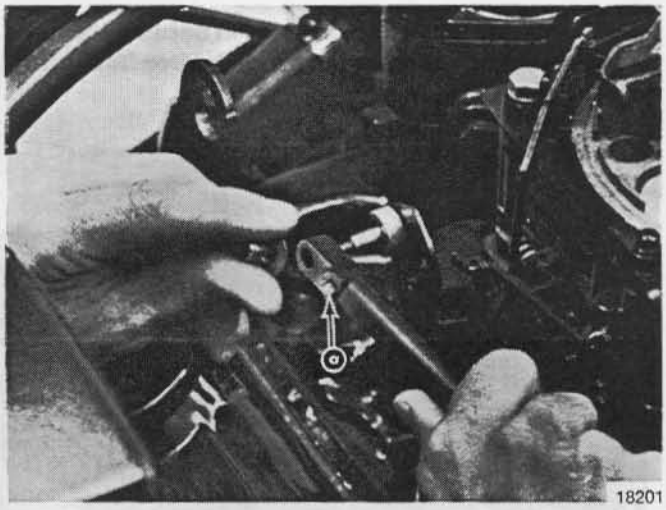
6. Disconnect throttle cable.



a - Throttle Cable

Removing Throttle Cable

7. Disconnect cable end guide.



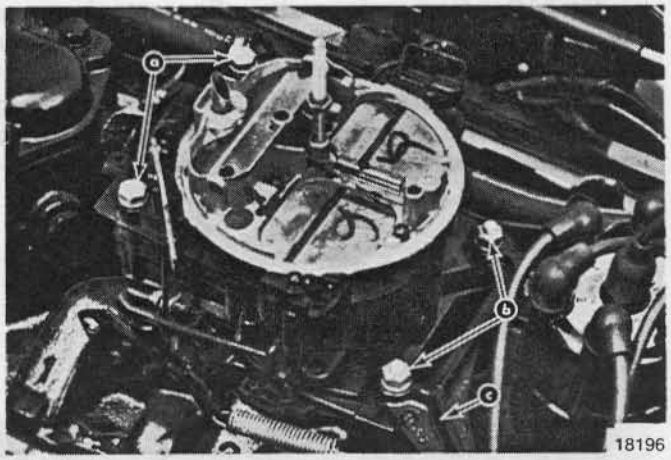
a - Cable End Guide

Removing Cable End Guide

8. Remove retaining nuts and bolts, remove carburetor and cable bracket.

IMPORTANT: Place a clean cloth over intake manifold opening to prevent dirt or foreign material from entering manifold.

9. Remove old gasket from carburetor and manifold.

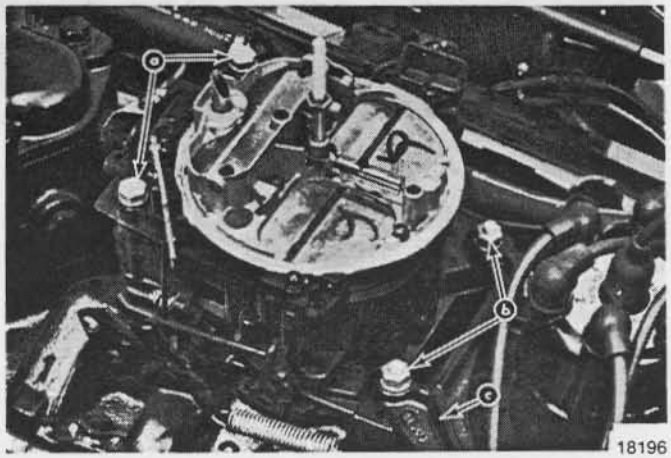


a - Bolts
b - Nuts
c - Cable Bracket

Removing Carburetor

Installation

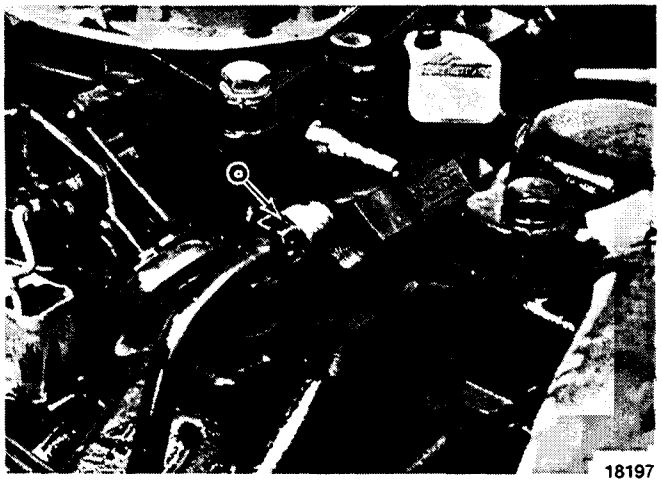
1. Install new gasket onto manifold.
2. Install carburetor and throttle bracket and torque to 132 lb. in. (15 N.m).



a - Mounting Bolts
b - Nuts
c - Throttle Bracket

Installing Carburetor

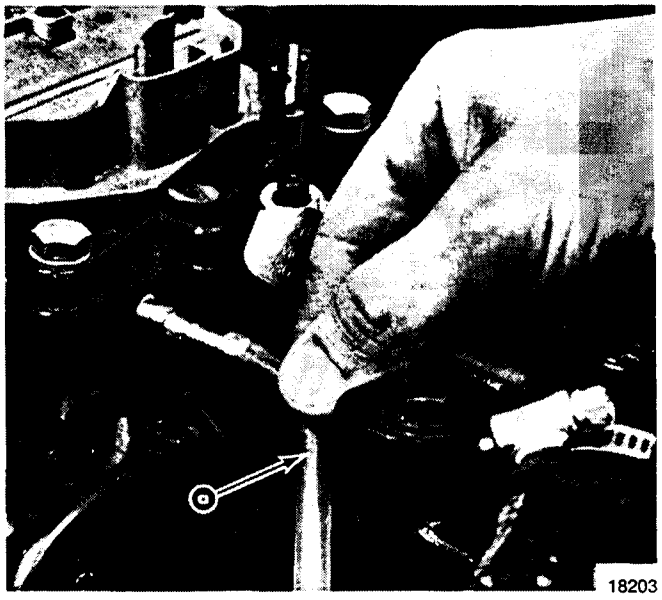
3. Connect fuel line and torque to 18 lb. ft. (24 N.m).



a - Fuel Line

Connecting Fuel Line

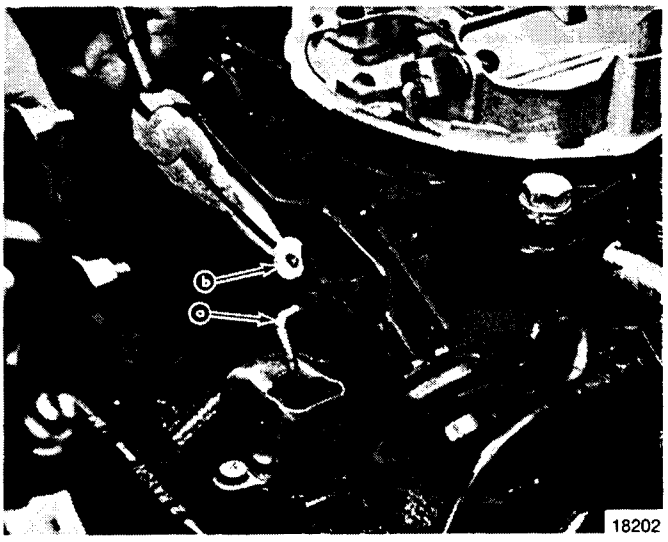
4. Connect fuel sight tube.



a - Sight Tube

Connecting Sight Tube

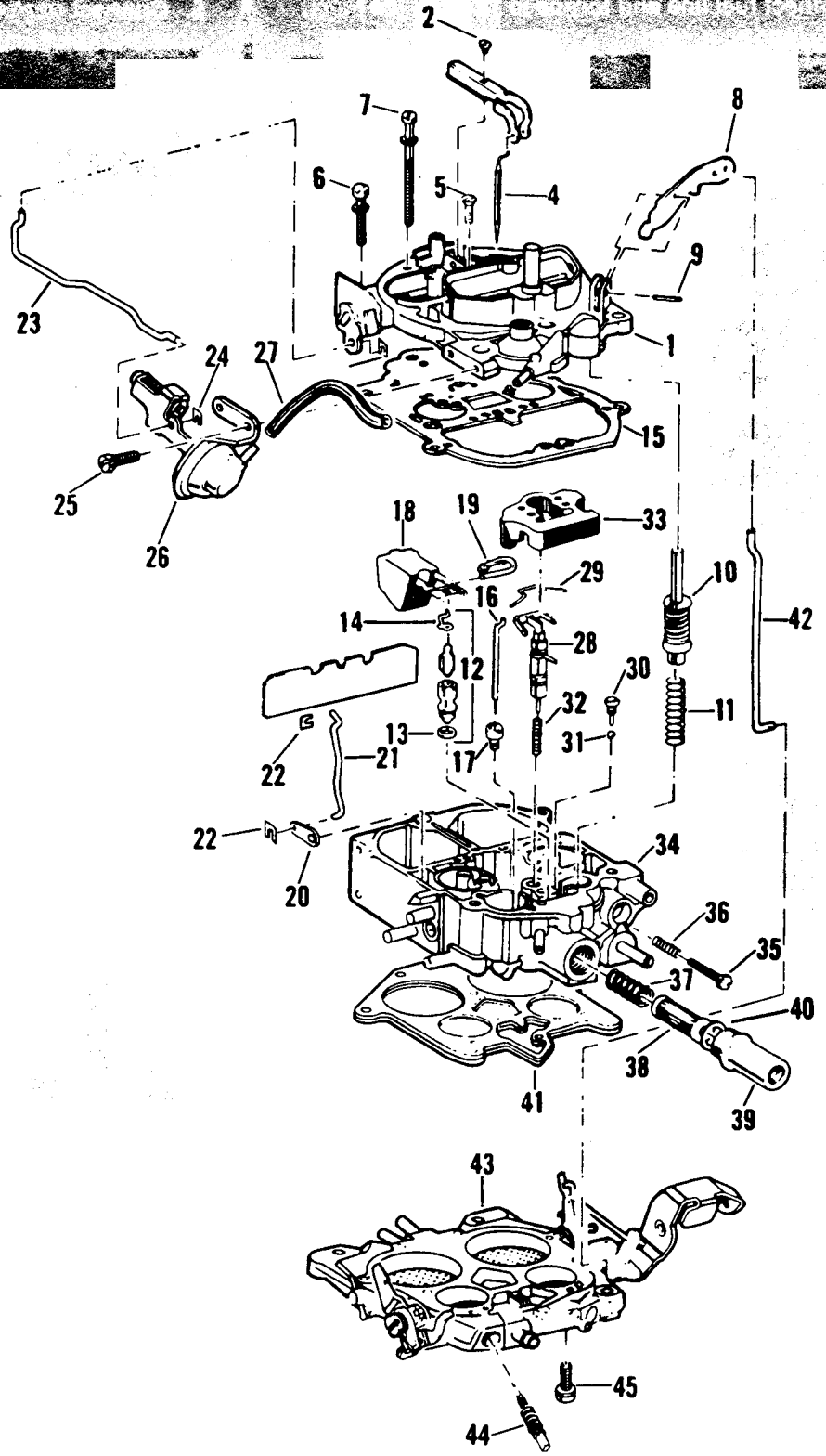
5. Connect choke link and install retaining clip.



a - Choke Link
b - Clip

Connecting Choke Spring Rod

6. To install throttle cable refer to "Section 2, Removal, Installation, and Alignment."
7. Install flame arrestor and tighten securely.
8. Reconnect battery cables to battery.
9. Start engine and check for gasoline leaks. If leaks exist, STOP ENGINE IMMEDIATELY and recheck connections.
10. Adjust idle speed and idle mixture, as outlined under "Adjustments" preceding.



1 - Air Horn Assembly
2 - Screw
3 - Hanger
4 - Metering Rod, secondary
5 - Screw
6 - Screw
7 - Screw
8 - Lever
9 - Roll Pin
10 - Pump
11 - Spring
12 - Needle and Seat
13 - Gasket
14 - Pull Clip
15 - Gasket
16 - Metering Rod, primary
17 - Jet, primary
18 - Float Assembly
19 - Pin, hinge - float
20 - Lever, intermediate choke
21 - Rod
22 - Clip
23 - Rod
24 - Clip
25 - Screw
26 - Control
27 - Hose
28 - Power Piston
29 - Retainer, power piston
30 - Retainer, pump discharge ball
31 - Ball, pump discharge
32 - Spring, power piston
33 - Insert, float bowl
34 - Float Bowl
35 - Screw, idle stop
36 - Spring, idle stop screw
37 - Spring, filter nut
38 - Filter, fuel inlet
39 - Nut, fuel inlet
40 - Gasket
41 - Gasket
42 - Rod
43 - Throttle Body
44 - Idle Needle
45 - Screw

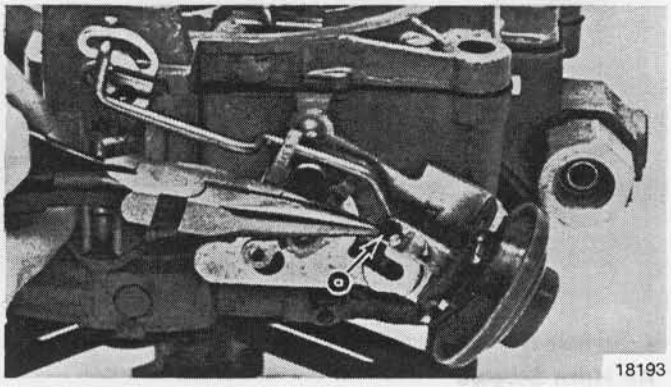
Rochester - 4MV/4MC Quadrajet

Disassembly

IMPORTANT: Place carburetor on a holding fixture to prevent throttle valve damage.

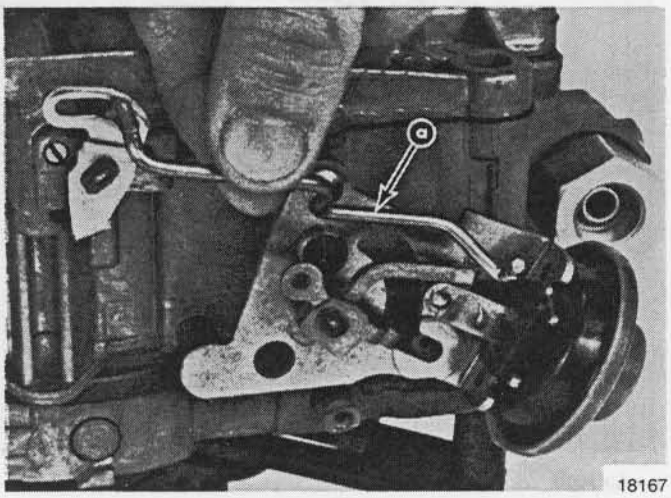
AIR HORN

1. Remove vacuum pump rod clip and rod.



a - Rod Clip

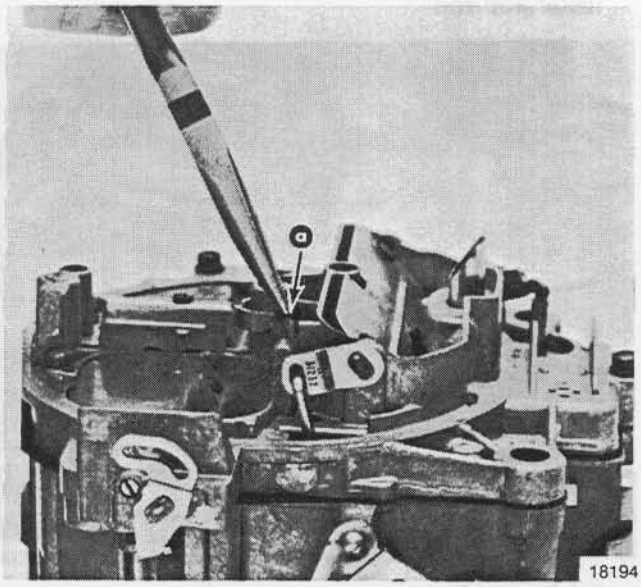
Removing Clip



a - Rod

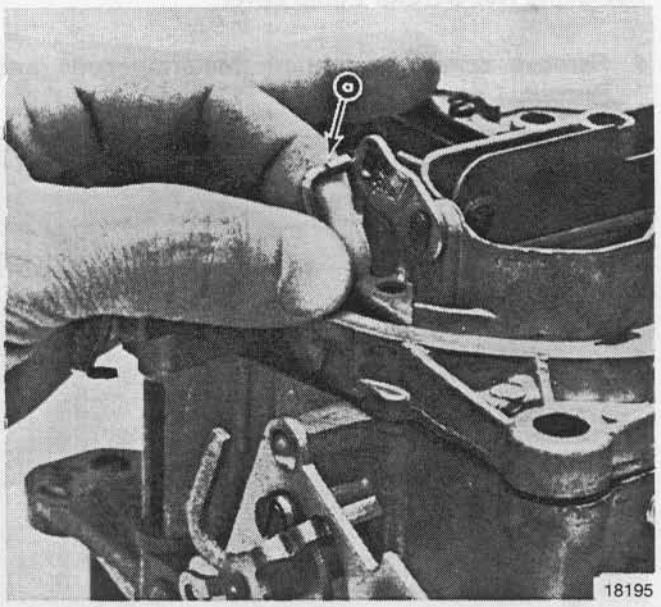
Removing Vacuum Pump Rod

2. Remove choke shutter clip and rod.



a - Clip

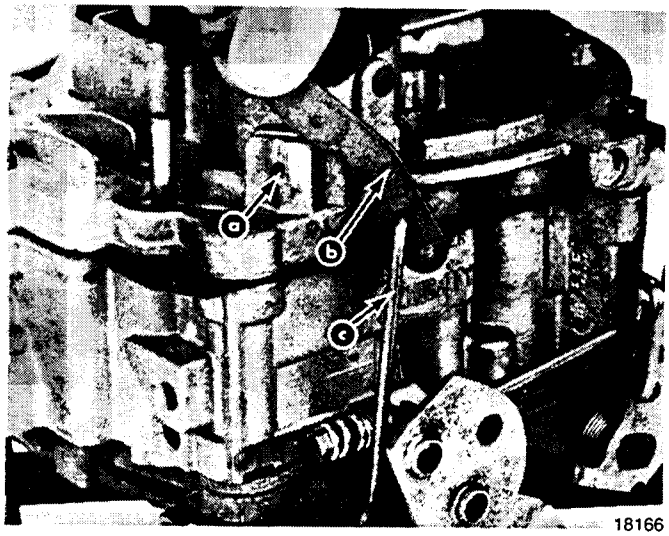
Removing Choke Rod Clip



a - Rod

Removing Choke Rod

3. Drive roll pin back and remove accelerator pump lever and rod.

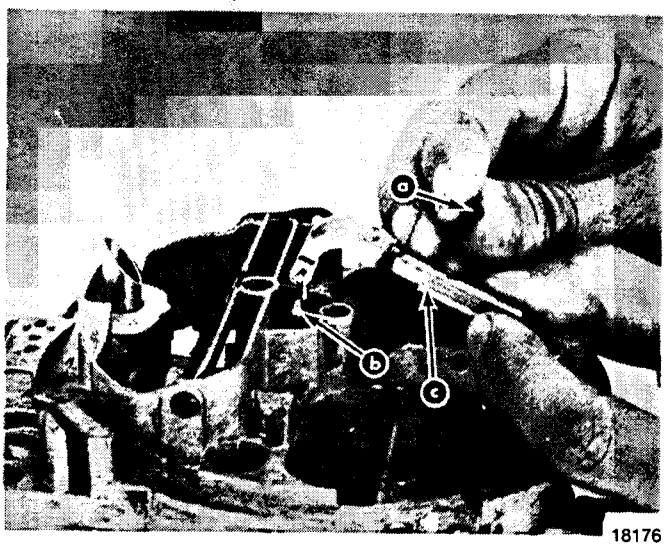


18166

a - Roll Pin (Not Shown)
b - Pump Lever
c - Rod

Removing Accelerator Pump Lever

4. Remove screw, secondary metering rods and hanger.

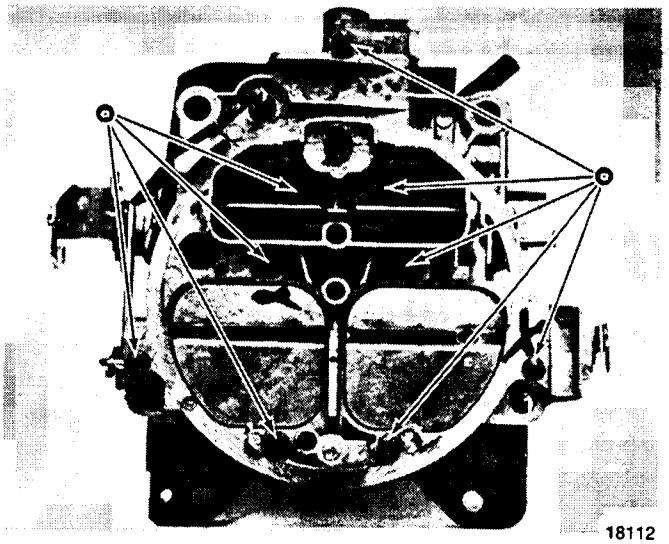


18176

a - Screw
b - Metering Rods
c - Hanger

Removing Metering Rods and Hanger

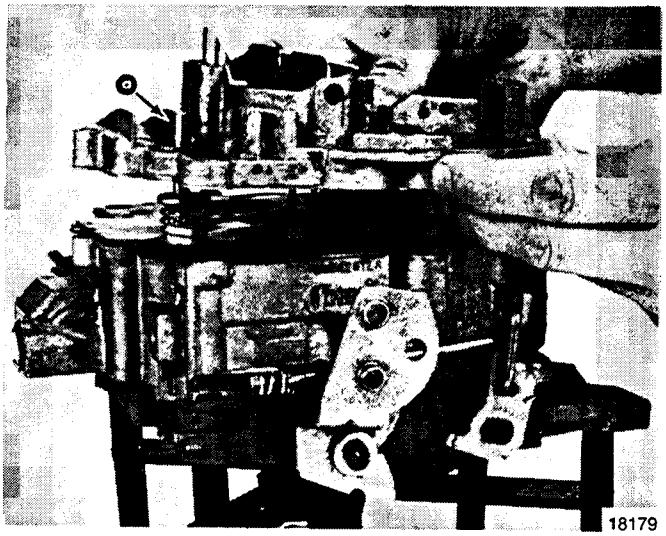
5. Remove air horn screws and air horn.



18112

a - Air Horn Screws

Air Horn Screws



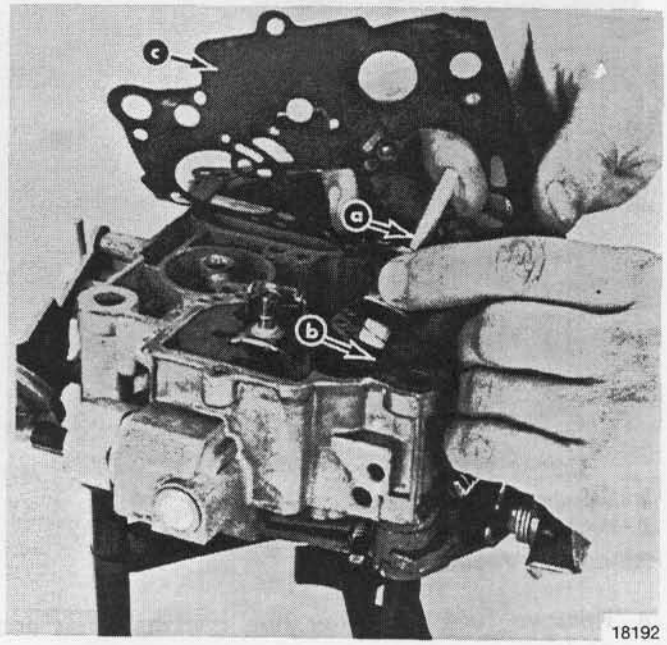
18179

a - Air Horn

Removing Air Horn

FLOAT BOWL

1. Remove pump plunger, return spring and gasket.

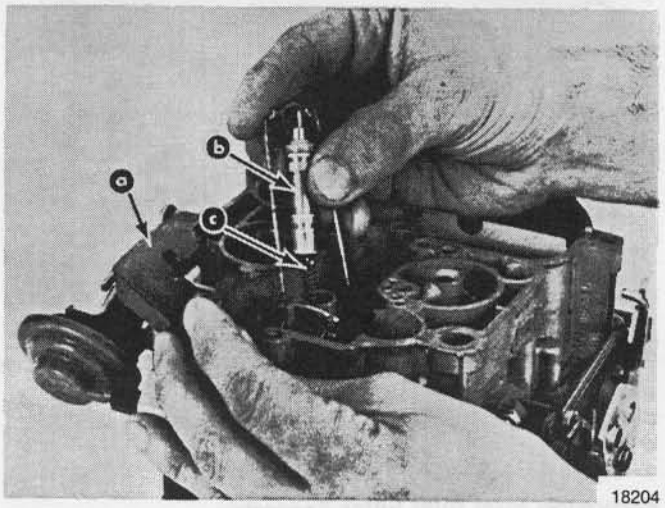


18192

a - Pump Plunger
b - Return Spring
c - Gasket

Removing Gasket and Accelerator Pump

2. Remove insert block, power piston and spring.

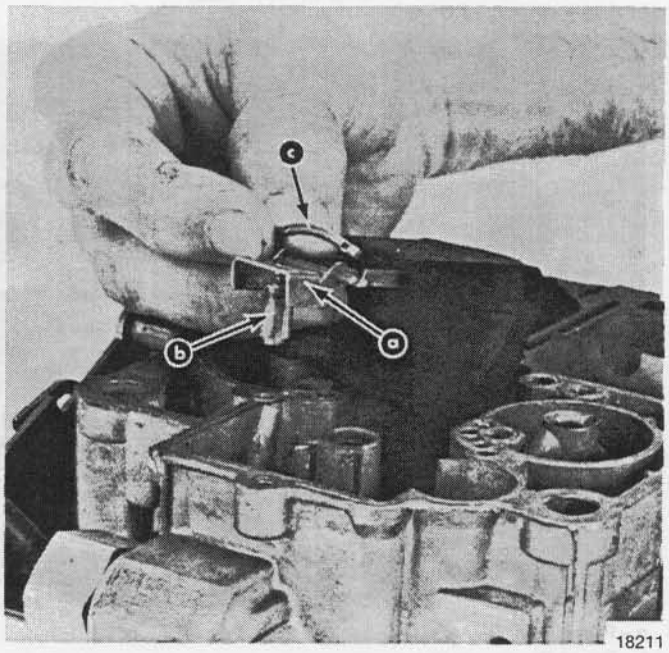


18204

a - Insert Block
b - Power Piston
c - Spring

Removing Insert Block and Power Piston

3. Remove float assembly, needle and retaining pin.

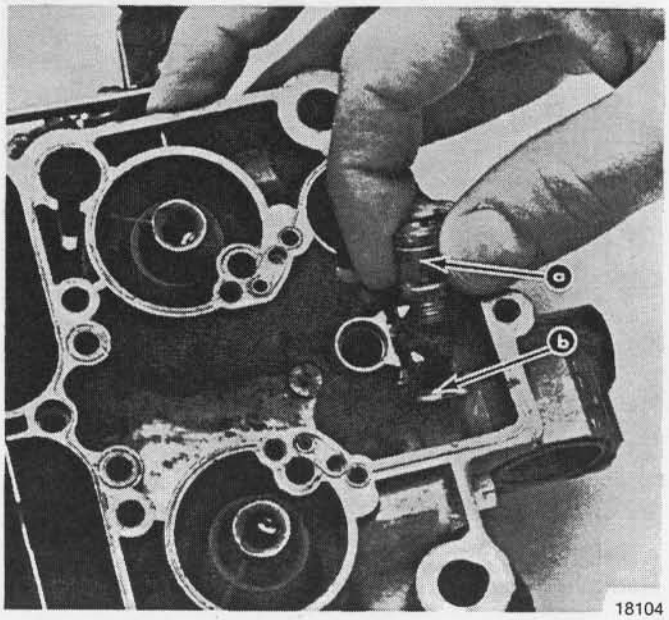


18211

a - Float Assembly
b - Needle
c - Retaining Pin

Removing Float and Inlet Needle

4. Remove fuel inlet seat and gasket.

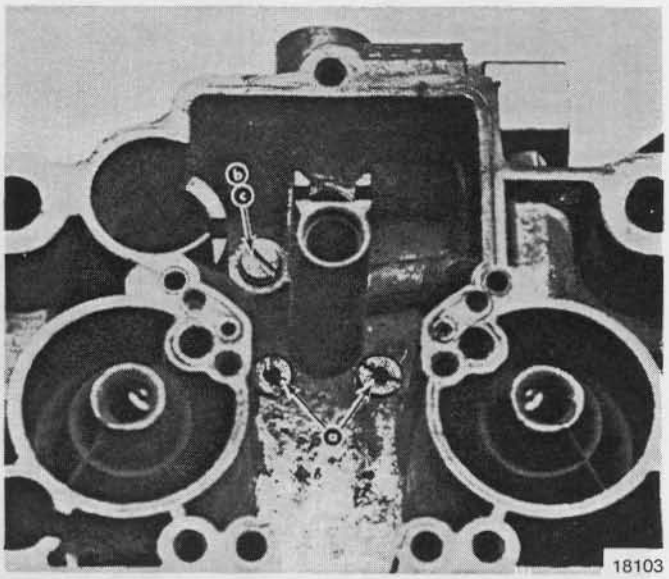


18104

a - Fuel Inlet Seat
b - Gasket

Removing Inlet Seat

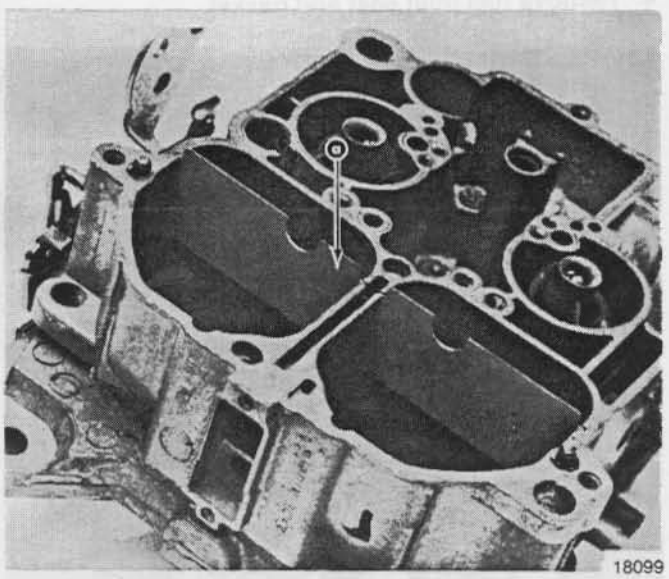
5. Remove primary metering jets, pump discharge check ball retainer and check ball.



a - Primary Metering Jets
b - Pump Discharge Retainer
c - Check Ball (Not Visible)

Removing Primary Jets and Retainer and Check Ball

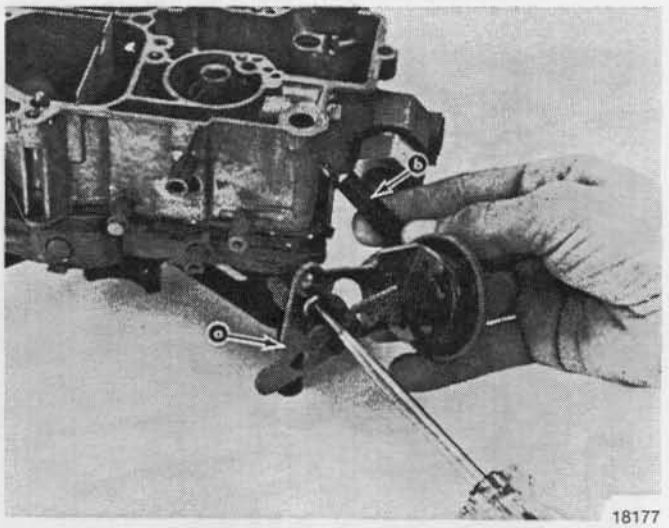
6. Remove baffle.



a - Baffle

Removing Baffle

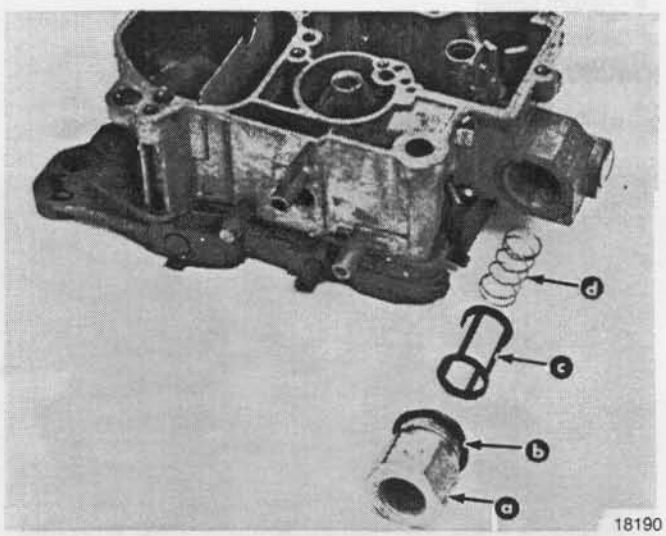
7. Remove vacuum control assembly and hose.



a - Vacuum Control Assembly
b - Hose

Removing Vacuum Control

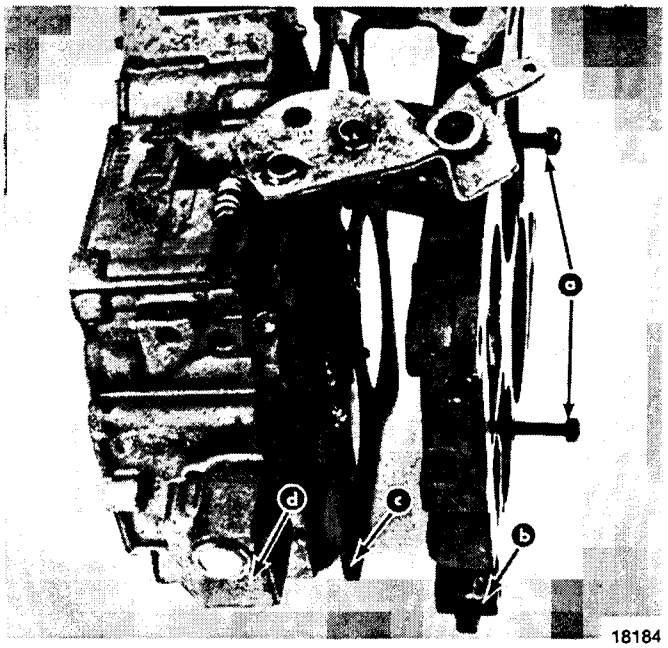
8. Remove fuel inlet filter nut, gaskets, filter and spring.



a - Nut
b - Gaskets
c - Filter
d - Spring

Removing Fuel Inlet Filter Assembly

9. Separate throttle body from float bowl and remove gasket.



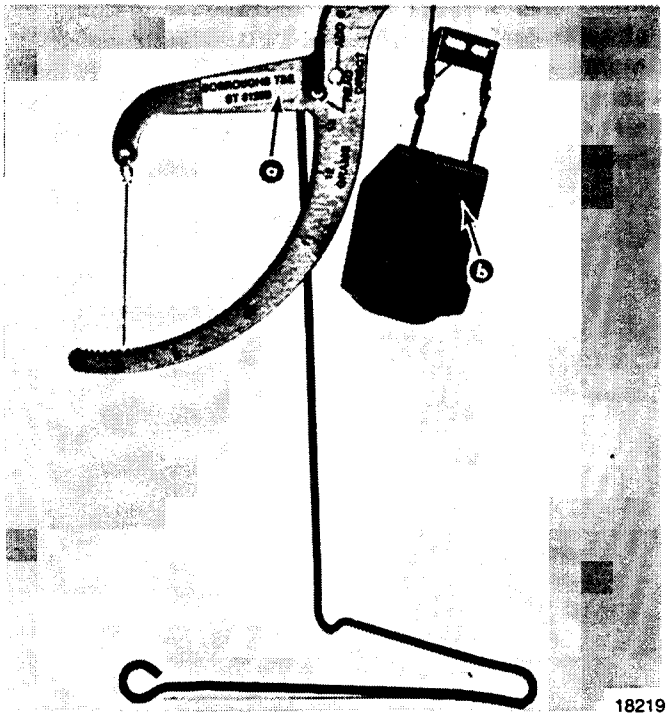
18184

a - Attaching Screws
b - Throttle Body
c - Gasket
d - Float Bowl

Removing Throttle Body

FLOAT WEIGHT

1. Assemble float scale to instructions with scale.
2. Check float weight to specifications.



18219

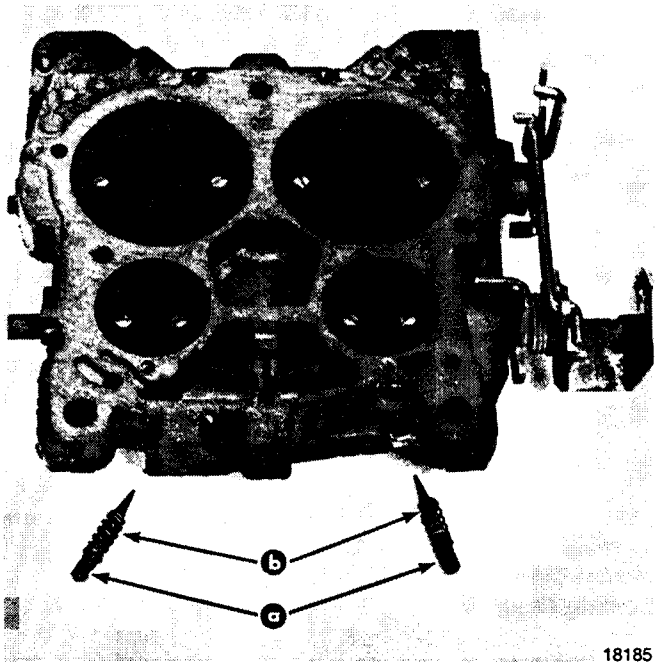
a - Float Scale
b - Float

Checking Float Weight

3. Replace float if it exceeds specifications.

THROTTLE BODY

1. Remove idle mixture screws and springs.



18185

a - Screw
b - Spring

Removing Idle Mixture Screws

IMPORTANT: Throttle body should not be disassembled any further than shown. Throttle body is serviced as an assembly.

Cleaning and Inspection

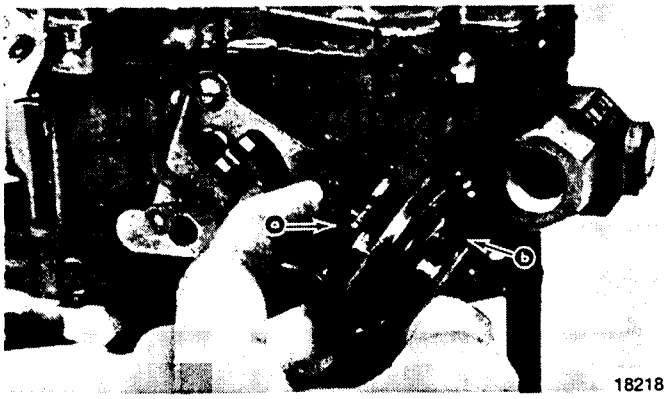
⚠CAUTION

Rubber, or plastic parts, pump plungers or diaphragms cannot be immersed in carburetor cleaner. The delrin air valve cam will withstand normal carburetor cleaner.

1. Clean carburetor in immersion type cleaner.
2. Blow out passages with compressed air. Do not drill thru passages.
3. Inspect for wear:
   - Idle mixture needles
   - Float needle and seat
   - Casting surfaces
   - All levers
   - Fast idle cam
   - Power piston
   - Acclerator pump seal
4. Check all valves for binding.

5. Check vacuum break unit for leaks.
   a. Depress plunger and seal hose connection.

⚠CAUTION
Do not leave carburetor in carb cleaner for more than two hours.



18218

a - Plunger
b - Hose Connection
Seating Plunger

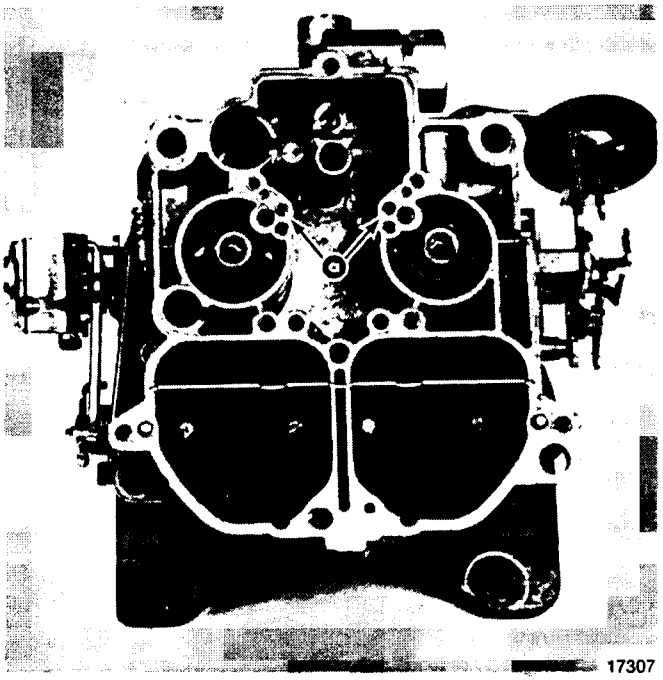
   b. Maintain seal on hose connection, plunger must remain seated. If plunger extends, replace unit.

18217

Plunger Seated and Hose Connection Sealed

IMPORTANT: The idle fuel pickup tubes have a smaller I.D. at the bottom than the top. Do not drill.

6. Clean idle fuel pickup tubes with a fine wire (approx. .020" O.D.) and blow out all channels with compressed air.



17307

a - Idle Fuel Pickup Tubes
b - Channel Restrictions
Cleaning Idle Passages

IMPORTANT: If engine is experiencing a rough idle situation and cannot be smoothed out with idle adjustment screws, drill out the channel restrictions to .055", using a No. 54 drill. Blow out channel with compressed air to clean out. Some later model carburetors already have this operation completed.

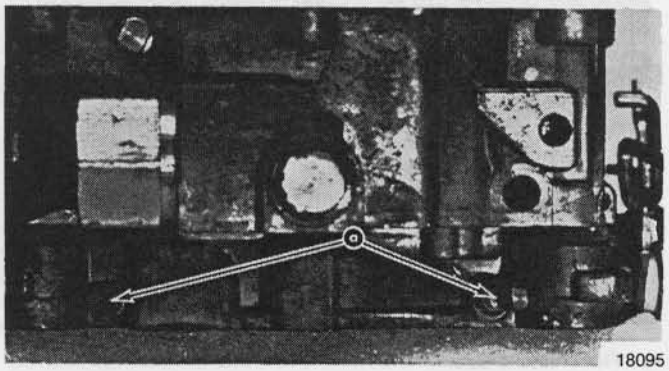
Reassembly

THROTTLE BODY

NOTICE
Refer to "Adjustments" for all adjustment procedures.

IMPORTANT: Seat idle mixture screws lightly or damage to needles and seats will result.

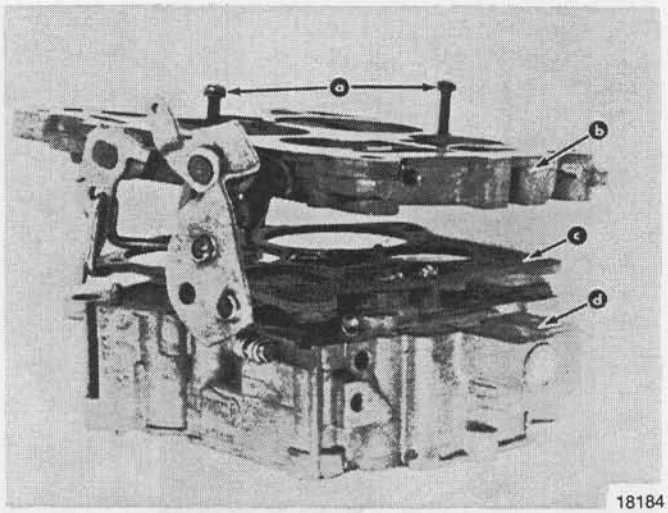
1. Install idle mixture needles and springs until lightly seated, then back out 2 to 3 turns.



a - Idle Mixture Needles and Springs

Installing Idle Mixture Needles

2. Install new gasket and assemble throtlle body to float bowl. Tighten securely.



a - Attaching Screws
b - Throttle Body
c - Gasket
d - Float Bowl

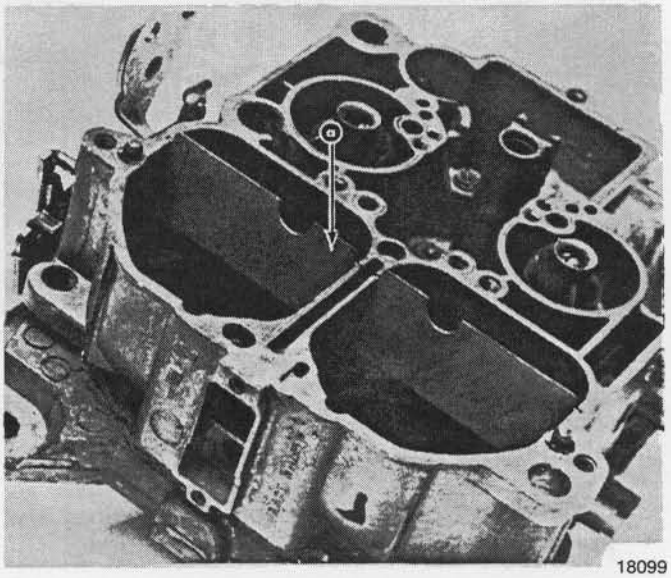
Installing Throttle Body

FLOAT BOWL

NOTICE
Refer to "Important Service Information" BEFORE proceeding.

IMPORTANT: Place carburetor on a holding fixture to prevent damage to throttle valve.

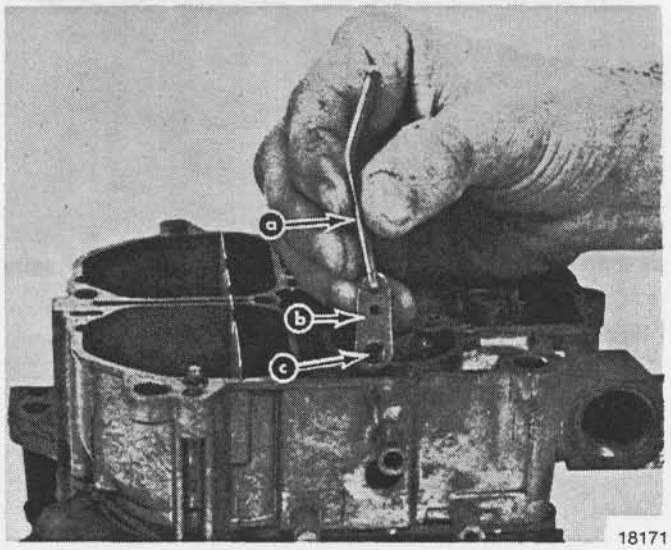
1. Install baffle plate.



a - Baffle Plate

Installing Baffle Plate

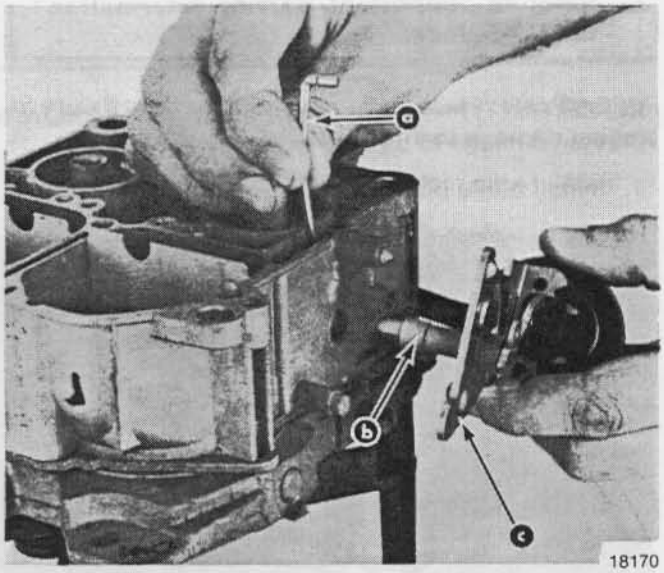
2. Install intermediate choke lever and vacuum break control bracket assembly.
   a. Using choke rod, suspend intermediate choke lever in float bowl cavity so that flat sided hole aligns with hole in side of float bowl.



a - Choke Rod
b - Choke Lever
c - Flat Sided Hole

Installing Choke Rod and Lever

b. Insert choke shaft on vacuum break control assembly to engage flat sided hole of choke lever, and secure with screw. Tighten securely.

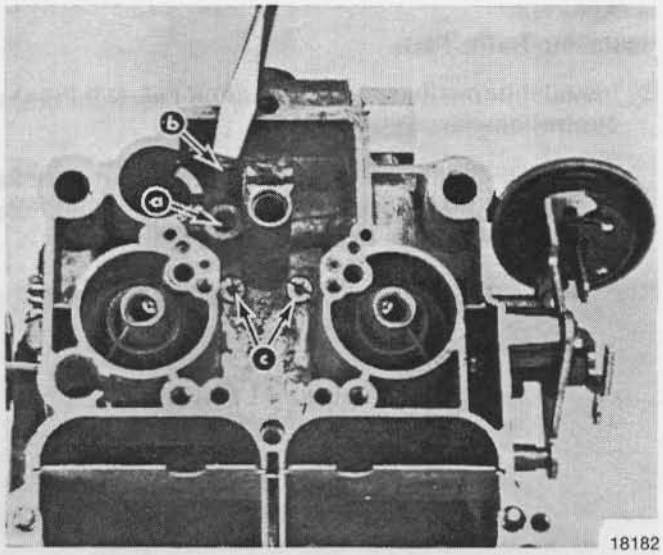


18170

a - Choke Rod
b - Choke Shaft
c - Vacuum Break Control Assembly

Installing Choke Rod to Vacuum Break

3. Install pump discharge check ball, retainer and primary main metering jets. Tighten securely.



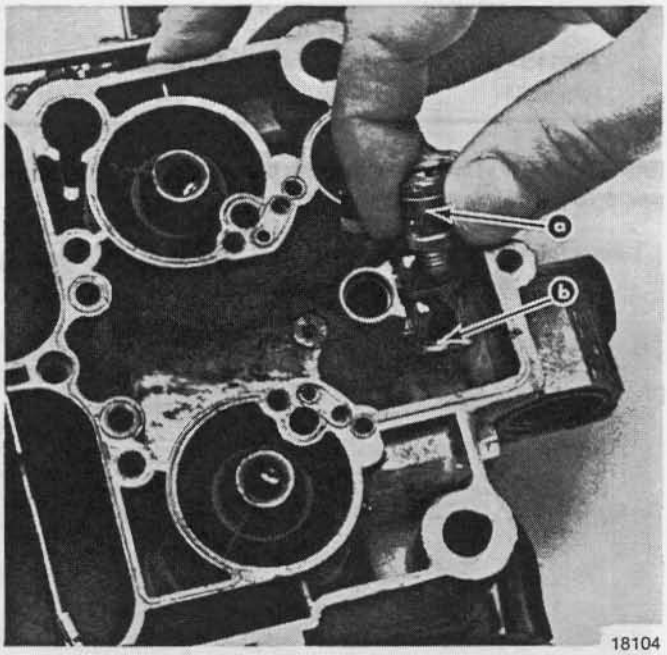
18182

a - Check Ball (Not Shown)
b - Retainer
c - Primary Main Metering Jets

Installing Check Ball, Retainer and Primary Jets

IMPORTANT: Float needle and seat should be replaced as a set only.

4. Install float needle seat and gasket.

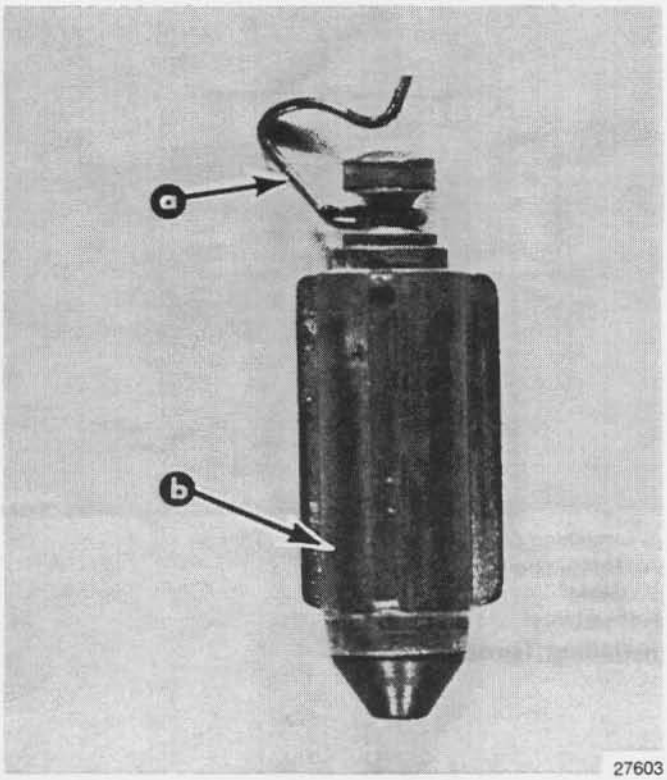


18104

a - Float Needle Seat
b - Gasket

Installing Needle Seat and Gasket

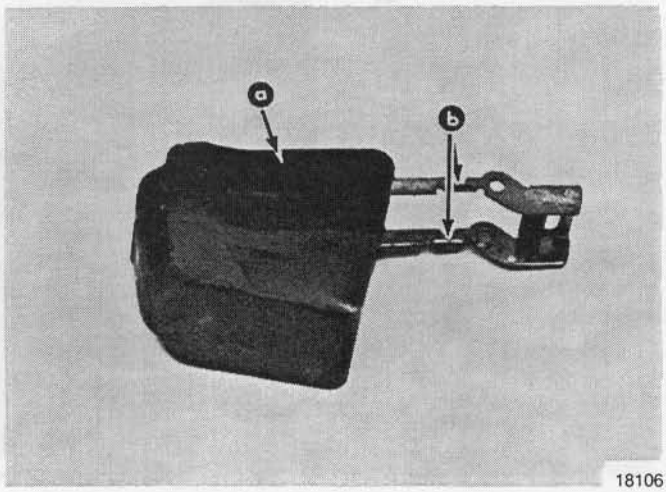
5. Installing float needle and float assembly.
   a. Install pull clip (a) onto needle (b).



27603

a - Pull Clip
b - Needle

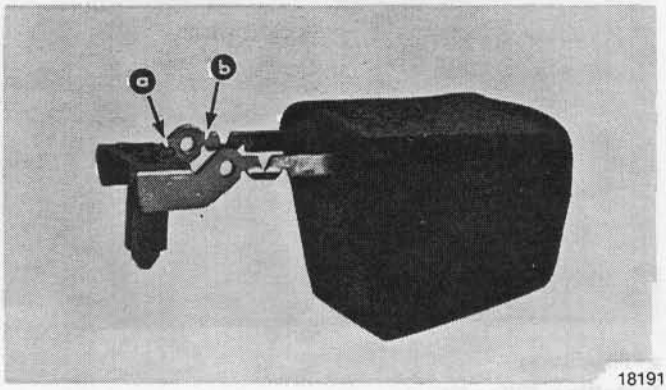
b. If a new float or needle and seat are used, bend float arm slightly upward at notch for easier adjustment.



a - Float
b - Float Arm Notch

Bending Float Arm

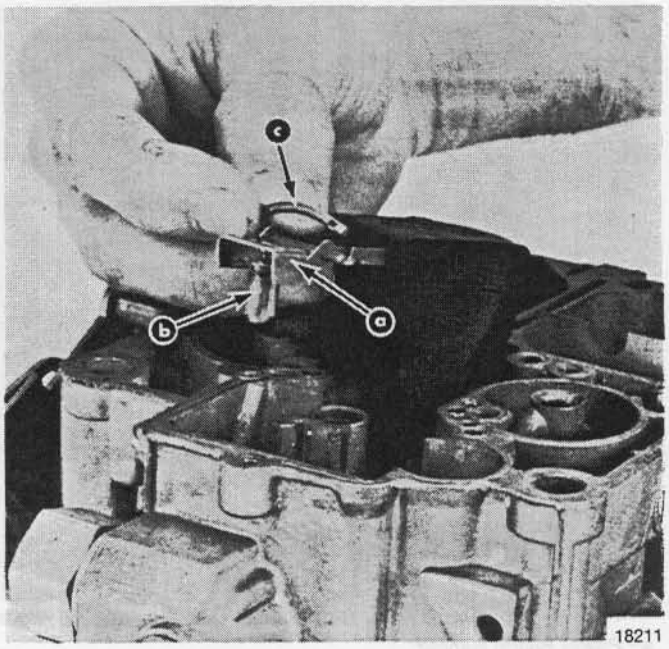
c. Hook needle pull clip over edge of float arm closest to pontoon.



a - Pull Clip
b - Float Arm

Proper Installation of Pull Clip

d. Install retaining pin into float arm and install float and needle into bowl.



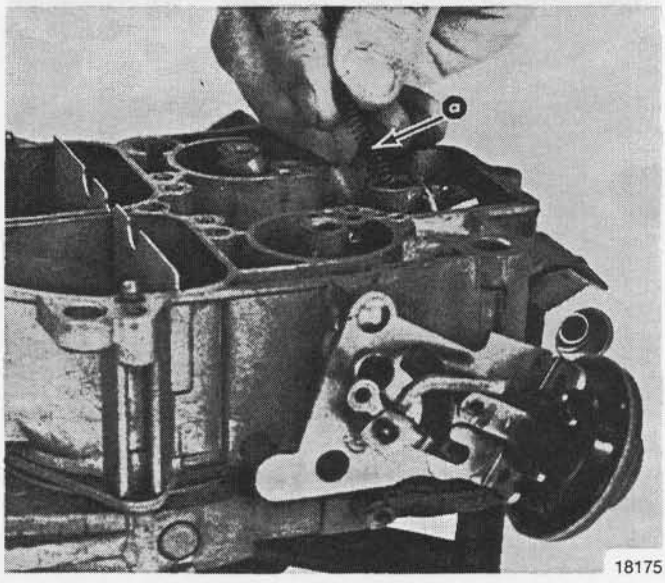
a - Float
b - Needle
c - Hinge Pin

Installing Float and Needle

IMPORTANT: Top of hinge pin must extend above casting by .010 for good pin retention.

e. Check float adjustment (refer to "Adjustment" in this section).

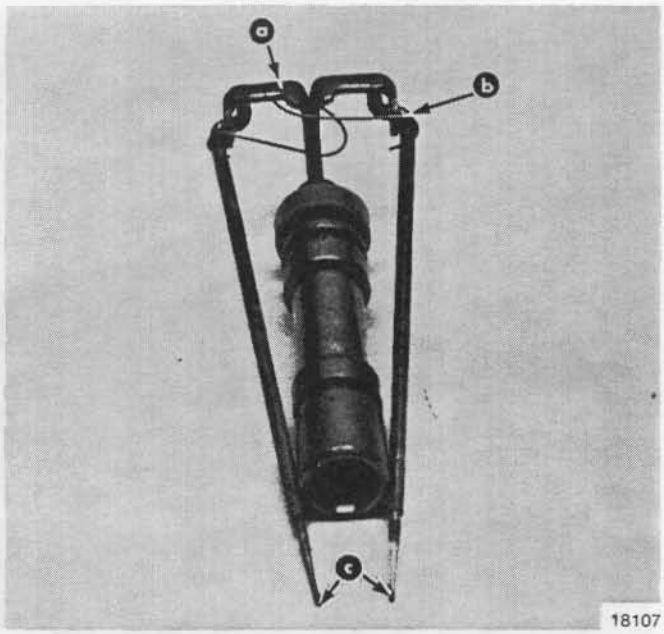
6. Install power piston spring.



a - Power Piston Spring

Installing Power Piston Spring

7. Install primary main metering rods in power piston hanger, and connect spring as shown.

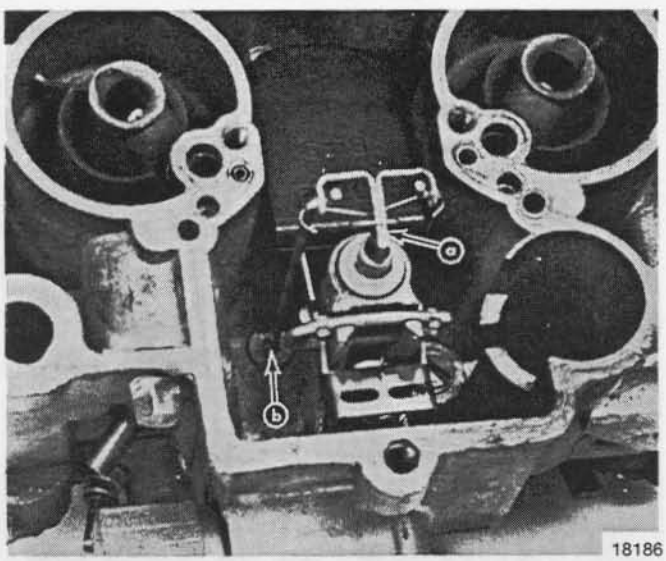


18107

a - Power Piston Hanger
b - Tension Spring
c - Metering Rods

Installing Primary Metering Rods

8. Install power piston assembly, guiding metering rod tips into main metering jets.

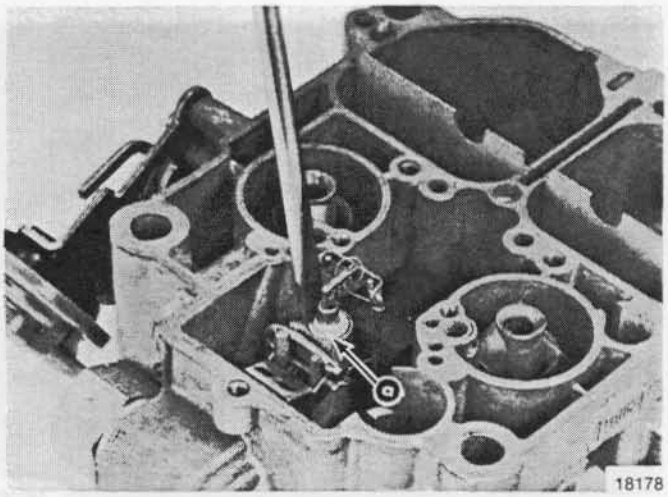


18186

a - Power Piston Assembly
b - Metering Rod Tip in Main Metering Jet

Installing Power Piston Assembly

9. Push power piston retainer down until flush with casting.

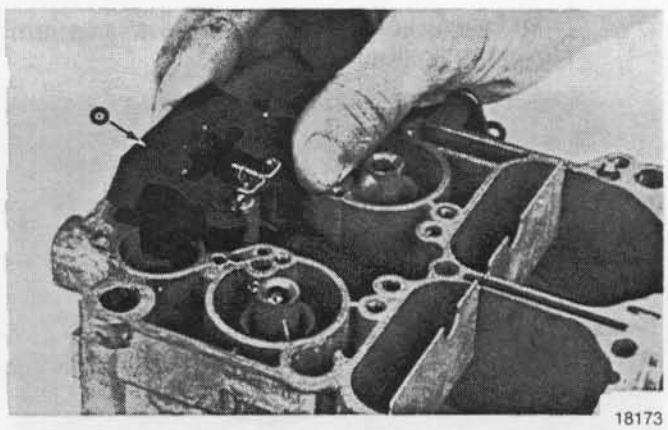


18178

a - Power Piston Retainer

Seating Power Piston

10. Install filler block.

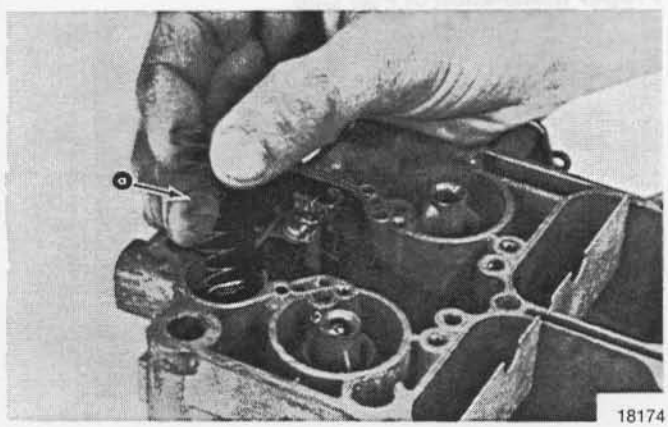


18173

a - Filler Block

Installing Filler Block

11. Install accelerator pump plunger spring.



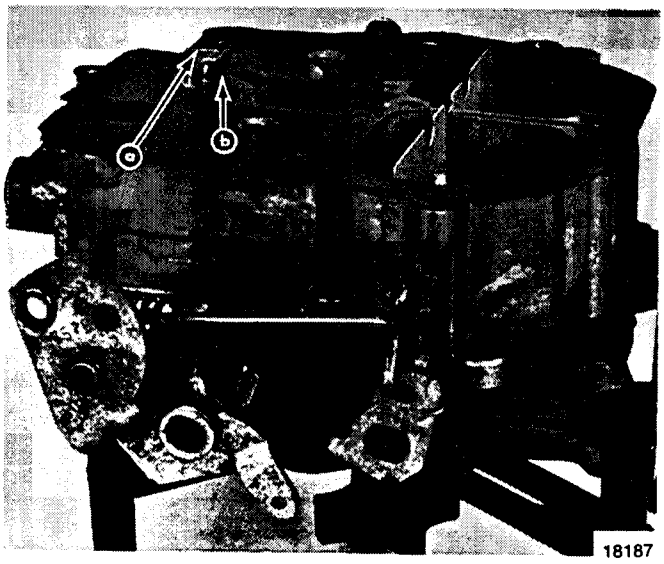
18174

a - Spring

Installing Pump Return Spring

AIR HORN

1. Install new gasket and slide tab under power piston hanger.



a - Power Piston Hanger
b - Gasket Tab

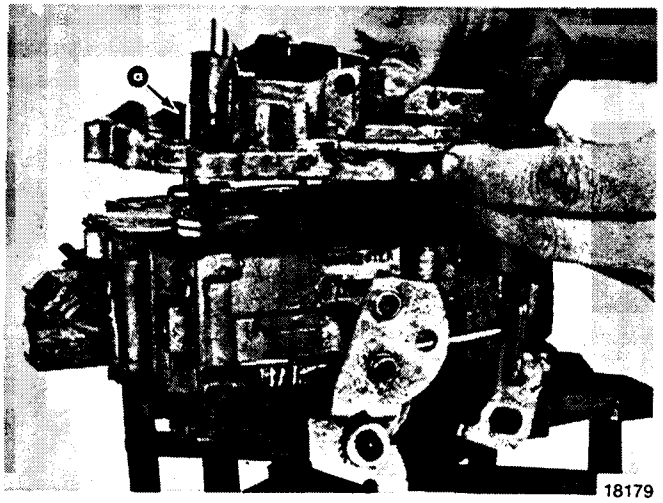
Proper Installation of Gasket

2. Install accelerator pump plunger.

a - Plunger

Installing Accelerator Pump

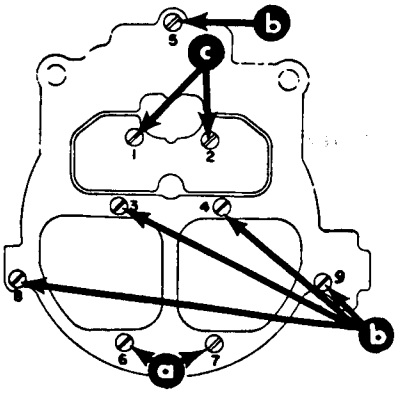
3. Install air horn.



a - Air Horn

Installing Air Horn

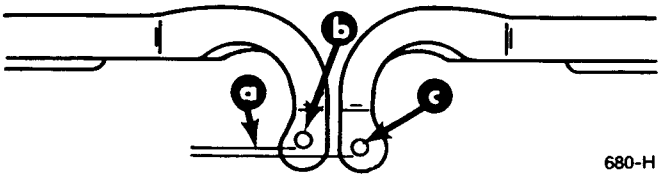
4. Install 9 attaching screws. Tighten securely in sequence as numbered.



a - Long
b - Short
c - Countersunk

Attaching Screw Installation

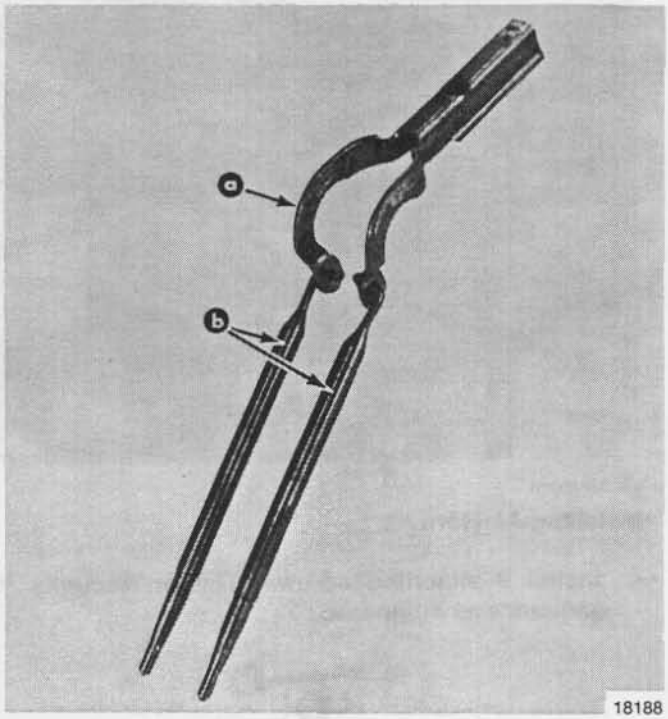
IMPORTANT: Hanger size may vary from specification chart. Manufacturer varies hanger size to make up differences in carburetor castings. Always install the same size hanger as was removed from the carburetor. Difference in hangers is the hole location, which affects secondary fuel metering.



a - Hole Location Changes Fuel Metering
b - Richer
c - Leaner

Hanger Size

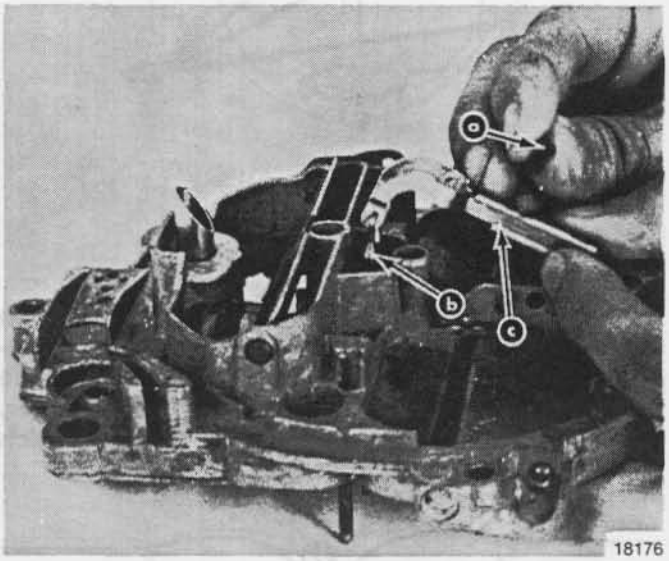
5. Install secondary metering rods into hanger with upper ends toward each other as shown.



a - Hanger
b - Metering Rods

Installing Metering Rods

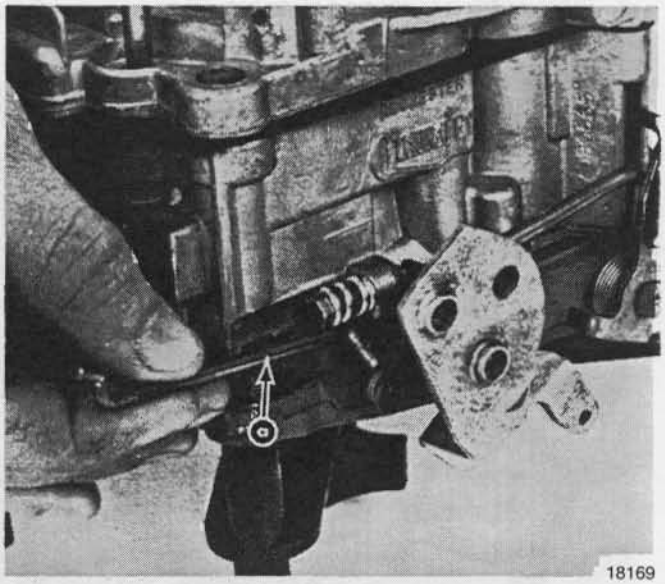
6. Install metering rods and hanger and secure with screw. Tighten securely.



a - Screw
b - Metering Rods
c - Hanger

Installing Hanger Assembly

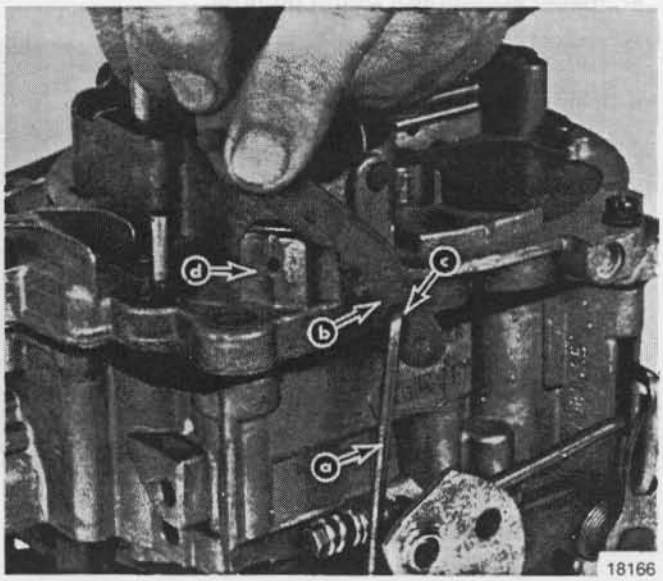
7. Install pump lever rod.



a - Pump Lever Rod

Installing Pump Lever Rod

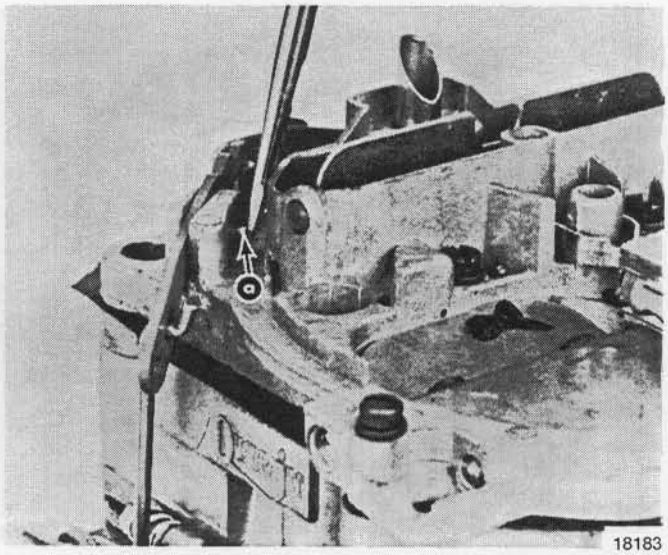
8. Install rod into lever inner hole and place lever into casting mount.



a - Rod
b - Lever
c - Inner Hole
d - Casting Mount

Locating Pump Lever Rod

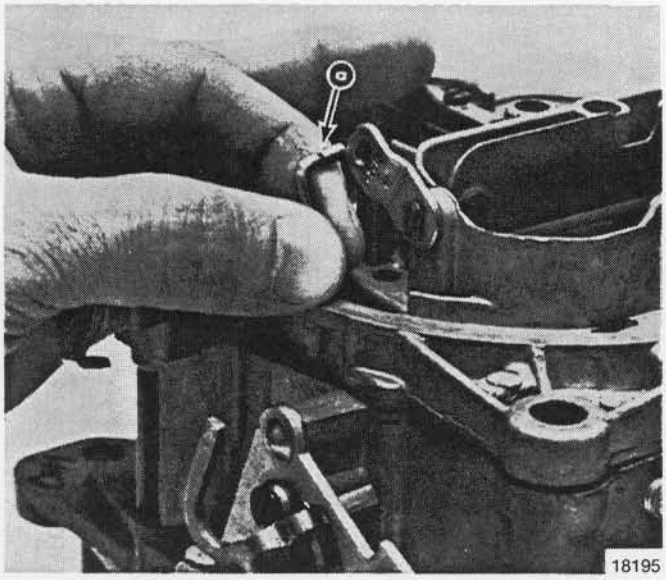
9. Press roll pin into place using a screwdriver.



a - Roll Pin

Installing Roll Pin

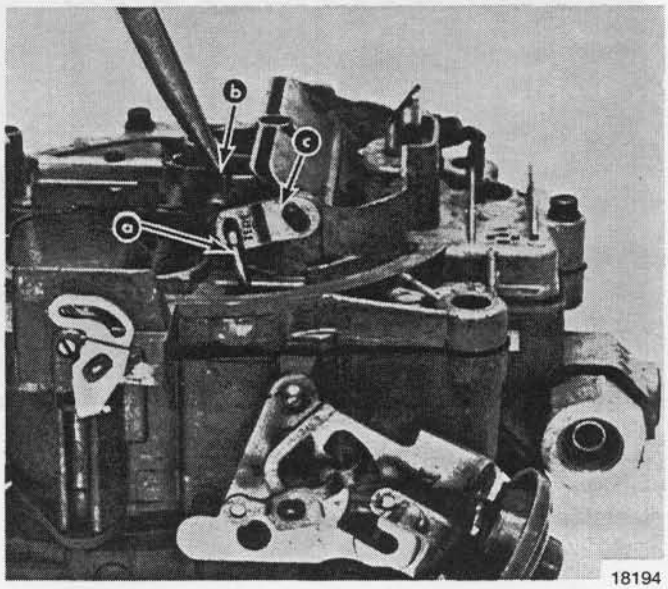
10. Install bottom end of choke shutter rod into intermediate choke lever in float bowl.



a - Choke Shutter Rod

Install Choke Shutter Rod to Intermediate Choke Lever

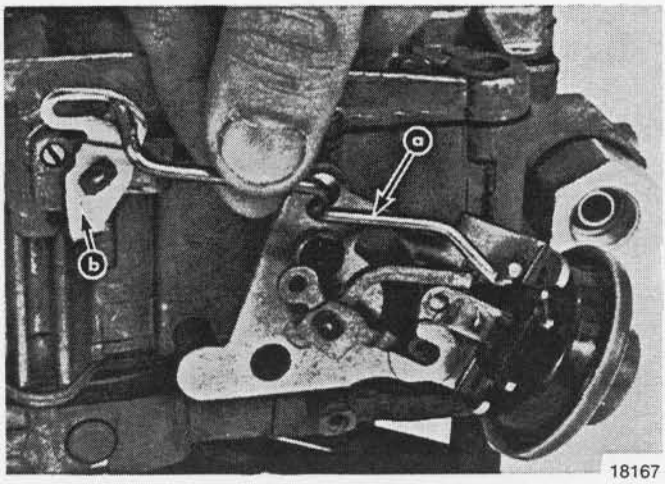
11. Install upper end of choke shutter rod into the choke blade lever, install clip onto choke shutter rod.



a - Choke Shutter Rod
b - Clip
c - Choke Blade Lever

Installing Upper End of Choke Shutter Rod

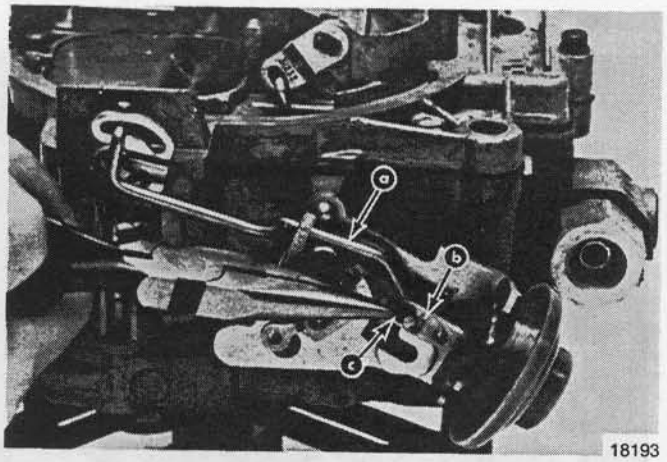
12. Install rod into air valve lever.



a - Rod
b - Air Valve Lever

Installing Air Valve Rod

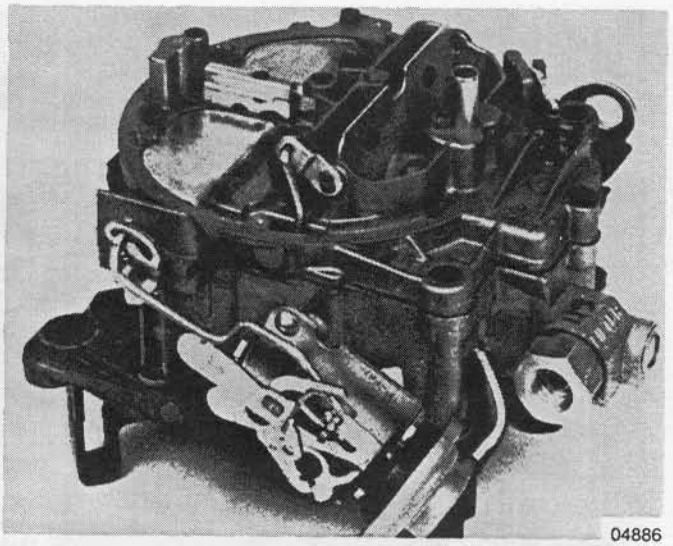
13. Install rod into vacuum break arm and install clip.



a - Rod
b - Vacuum Break Arm
c - Clip

Installing Rod to Break Arm

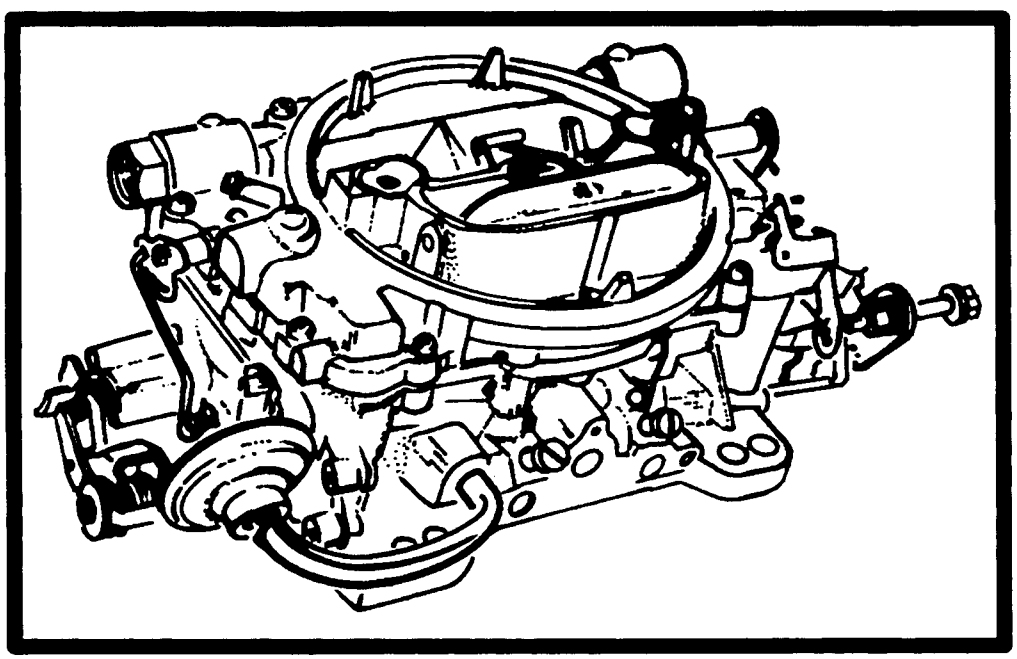
14. Install vacuum break hose.



a - Fittings
b - Hose

Installing Vacuum Hose

FUEL SYSTEMS



WEBER CARBURETOR

5

D

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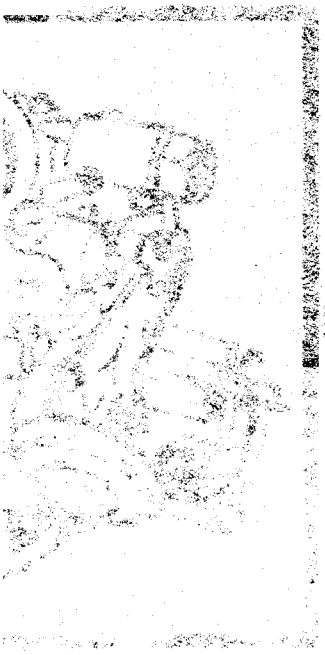
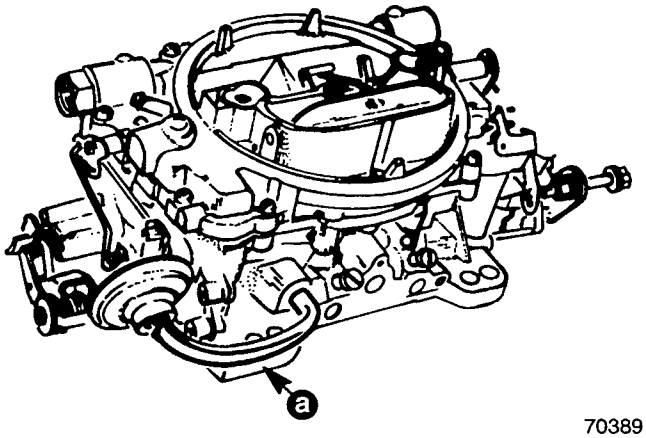


Identification



70389

a - Weber Identification Number Location

Replacement Parts Warning

⚠ WARNING

Electrical, ignition and fuel system components on your MerCruiser are designed and manufactured to comply with U. S. Coast Guard Rules and Regulations to minimize risks of fire and explosion.

Use of replacement electrical, ignition or fuel system components, which do not comply with these rules and regulations, could result in a fire or explosion hazard and should be avoided.

Torque Specifications

Fastener Location	Lb.Ft.(N·m)	Lb.In.(N·m)
Carburetor to Manifold		132 (15)
Fuel Line To Carburetor	18 (24)	

Tools

MERCURY MARINE SPECIAL TOOLS	
91-36392	Universal Carburetor Gauge
91-59339	Tachometer

OTHER SPECIAL TOOLS	
Obtain Locally	Universal Carburetor Stand
	Torx® Screwdrivers (15,20,25)

TORX® SCREWDRIVERS

Weber carburetors will have a "star" shaped socket in the head of some screws. A TORX® screwdriver must be used on this type of screw. The sizes used are Number 15, 20 and 25.

MCM Carburetor Specifications

Engine Model	Carb Type	Mercury Number (Manufacturer Number)	Jet Location	Primary Jet Size	Secondary Jet Size	Metering Rod Number	Metering Rod Spring Color
MCM 350 Magnum	Weber WFB	3310-816343 (9770)	Throttle Lever Side	.101 in.	.092 in.	16-6852	Natural
MCM 5.7L Bravo			Choke Rod Side	.101 in.			
MCM 7.4L Bravo	Weber WFB	3310-818659 (9772)	Throttle Lever Side	.101 in.	.098 in.	16-6542	Pink
			Choke Rod Side	.113 in.	.077 in.		
MCM 454 Magnum Bravo	Weber WFB	3310-816917 (9773)	Throttle Lever Side	.107 in.	.107 in.	16-6542	Pink
			Choke Rod Side	.107 in.	.107 in.		
MCM 502 Magnum Bravo	Weber WFB	3310-805341 (9776)	Throttle Lever Side	.110 in.	.101 in.	16-7147	Pink
			Choke Rod Side	.110 in.	.101 in.		

MIE Carburetor Specifications

Engine Model	Carb Type	Mercury Number (Manufacturer Number)	Jet Location	Primary Jet Size	Secondary Jet Size	Metering Rod Number	Metering Rod Spring Color
MIE 350 Magnum Tournament Ski	Weber WFB	3310-816343 (9770)	Throttle Lever Side	.101 in.	.092 in.	16-6852	Natural
			Choke Rod Side	.101 in.			
MIE 7.4L	Weber WFB	3310-818659 (9772)	Throttle Lever Side	.101 in.	.098 in.	16-6542	Pink
			Choke Rod Side	.113 in.	.077 in.		
MIE 8.2L	Weber WFB	3310-817693 (9774)	Throttle Lever Side	.104 in.	.098 in.	16-6542	Pink
			Choke Rod Side	.107 in.	.098 in.		

UNIT OF MEASUREMENT
in. (mm)

MCM Carburetor Adjustment Specifications (Note 1)

Engine Model	MCM 350 Magnum	MCM 5.7L Bravo	MCM 7.4L Bravo	MCM 454 Magnum Bravo	MCM 502 Magnum Bravo
Make and Model	Weber WFB				
Carb Manufacturer Number	9770		9772	9773	9776
Float Level	1-9/32 in. (33mm)				
Float Drop	2 in. (51mm)				
Pump Rod Hole Location	#3 from End				
Accelerator Pump	7/16 in. (11mm) NOTE:1				
Choke Pull-Off	1/8 in. (3.5mm)				
Choke Coil Rod	Top of Rod Even with Bottom of Lever Hole - NOTE:2				

NOTE 1: Measured from Top of Carburetor to Bottom of "S" Link
NOTE 2: Remove choke rod from lever hole. Choke held closed and choke rod pushed down with top edge of rod even with bottom edge of hole.

MIE Carburetor Adjustment Specifications (Note 1)

Engine Model	MIE 350 Magnum Tournament Ski	MIE 7.4 Litre	MIE 8.2 Litre
Make and Model	Weber WFB		
Carb Manufacturer Number	9770	9772	9774
Float Level	1-9/32 in. (33mm)		
Float Drop	2 in. (51mm)		
Pump Rod Hole Location	#3 from End		
Accelerator Pump	7/16 in. (11mm) NOTE:1		
Choke Pull-Off	1/8 in. (3.5mm)		
Choke Coil Rod	Top of Rod Even with Bottom of Lever Hole - NOTE:2		

NOTE 1: Measured from Top of Carburetor to Bottom of "S"-Link
NOTE 2: Remove choke rod from lever hole. Choke held closed and choke rod pushed down with top edge of rod even with bottom edge of hole.

Description

Weber WFB carburetor is unique in design, as the main body and flange are cast as a one piece unit. This, along with the bowl cover, make up the two piece construction which is made of light, durable aluminum to dissipate heat.

There are two separate float circuits. Each float circuit supplies fuel to a primary low speed circuit and a primary and secondary high speed circuit. The bowls are vented to the inside of the air horn. A connecting vent passage effects a balance of the air pressure between the two bowls.

The float needle valves are installed at an angle to provide the best possible seating action on the needles. This provides better needle response to float movement, also.

The high speed circuits use staged step-up rods in the main metering jets to control the amount of fuel admitted to the nozzles. The position of the step-up rod is controlled by manifold vacuum applied to the vacuum piston.

A primary air bleed located in the venturi cluster prevents a rich condition or bog as the high speed circuit is reactivated after deceleration.

Small "L" shaped metal tabs, called "Distribution Tab(s)" attach to primary venturi clusters and protrude into the air stream at the proper location to aid distribution of fuel on selected applications.

Precautions

⚠ WARNING

Always disconnect battery cables from battery BEFORE working on fuel system to prevent fire or explosion.

⚠ WARNING

Be careful when cleaning flame arrestor and crankcase ventilation hose; gasoline is extremely flammable and highly explosive under certain conditions. Be sure that ignition key is "OFF". DO NOT smoke or allow sources of spark or open flame in area when cleaning flame arrestor and crankcase ventilation hose.

⚠ WARNING

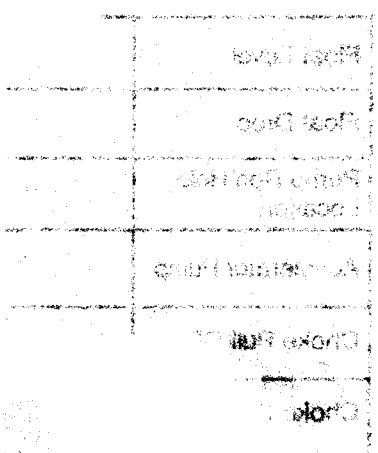
Be careful when changing fuel system components: gasoline is extremely flammable and highly explosive under certain conditions. Be sure that ignition key is "OFF". DO NOT smoke or allow sources of spark or open flame in area while changing fuel filter. Wipe up any spilled fuel immediately.

⚠ WARNING

Make sure no fuel leaks exist , before closing engine hatch.

⚠ CAUTION

DO NOT operate engine without cooling water being supplied to water pickup holes in gear housing or water pickup inlet, or water pump impeller will be damaged and subsequent overheating damage to engine may result.



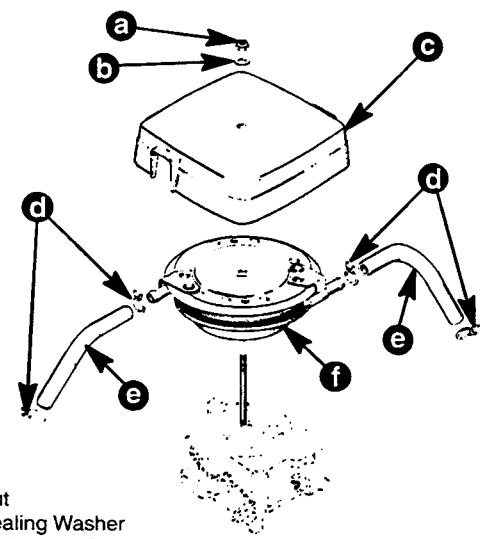
Maintenance

Flame Arrestor

NOTICE

Refer to "Precautions" in this section BEFORE proceeding.

1. Remove (in the following order):
   a. Nut
   b. Sealing Washer
   c. Carburetor Cover
   d. Crankcase Ventilation Hoses - From Flame Arrestor and Rocker Arm Covers
   e. Flame Arrestor
2. Clean and inspect:
   a. Clean flame arrestor in solvent and blow dry with compressed air.
   b. Clean crankcase ventilation hoses.
   c. Inspect crankcase ventilation hoses for cracks or deterioration, and replace if necessary.
3. Install (in the following order):
   a. Flame Arrestor
   b. Crankcase Ventilation Hoses - To Flame Arrestor and Rocker Arm Covers
   c. Carburetor Cover
   d. Sealing Washer
   e. Nut - Tighten securely.



a - Nut
b - Sealing Washer
c - Carburetor Cover
d - Clamps
e - Crankcase Ventilation Hose(s)
f - Flame Arrestor

71372

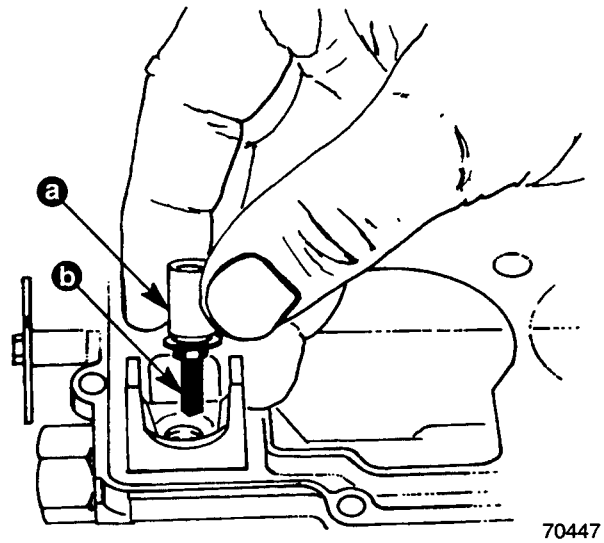
Flame Arrestor with Carburetor Cover (Typical)

Fuel Filter

NOTICE

Refer to "Precautions" in this section BEFORE proceeding.

Carburetor inlet fuel filter is installed in bottom side of inlet seat (in the carburetor top). Refer to "Disassembly" and "Assembly" instructions to service.



70447

a - Inlet Seat (With Gasket)
b - Inlet Filter

Adjustments

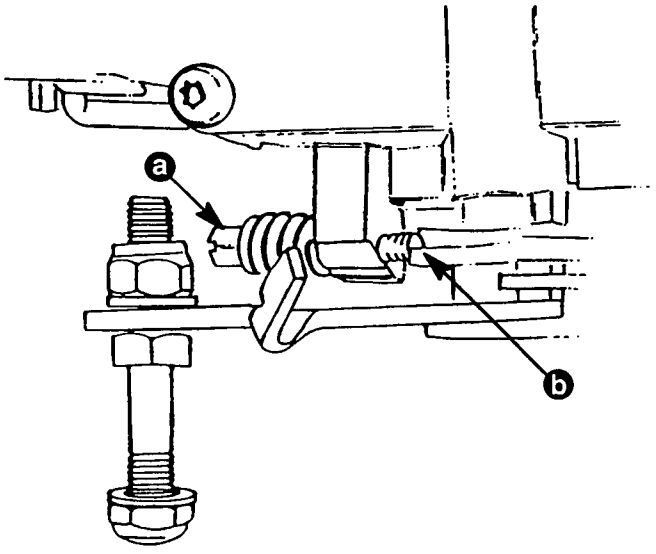
NOTICE

Refer to "Precautions" in this section BEFORE proceeding.

Accelerator Pump

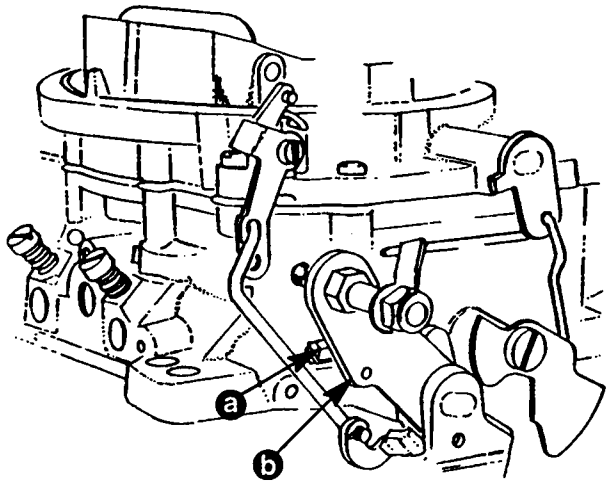
IMPORTANT: The accelerator pump linkage is attached in the third hole from the end of the pump lever.

1. Back out idle speed screw until it no longer contacts throttle lever.



70474

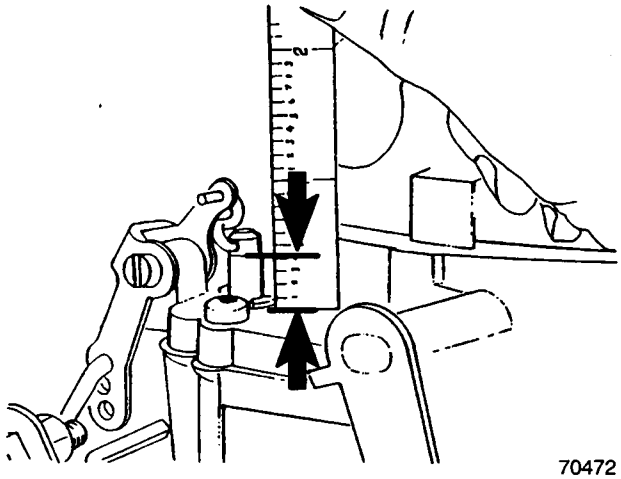
a - Idle Speed Screw
b - Throttle Lever Contact Point



70473

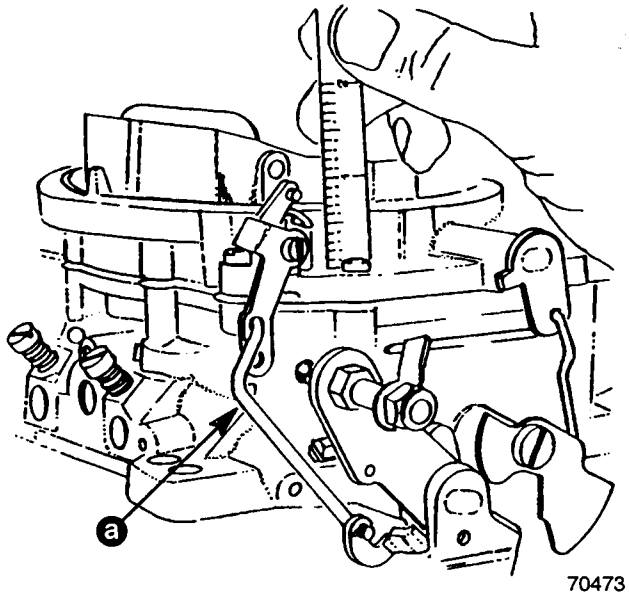
a - Idle Speed Screw
b - Throttle Lever

2. Close throttle valves completely.
3. Accelerator Pump is set at 7/16 in. (11mm), which is measured from the carburetor top to the bottom of the "S"-Link as shown.



70472

4. Adjustment of accelerator pump is done by bending the linkage as necessary to achieve the proper dimension as stated above.

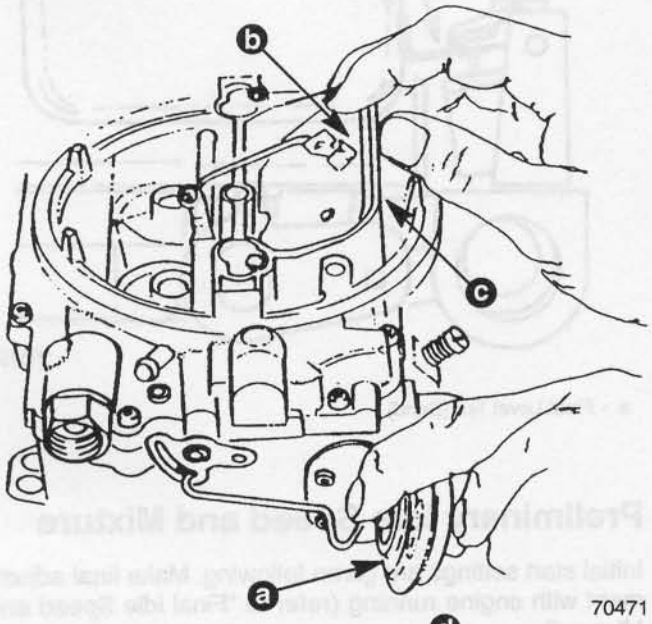


70473

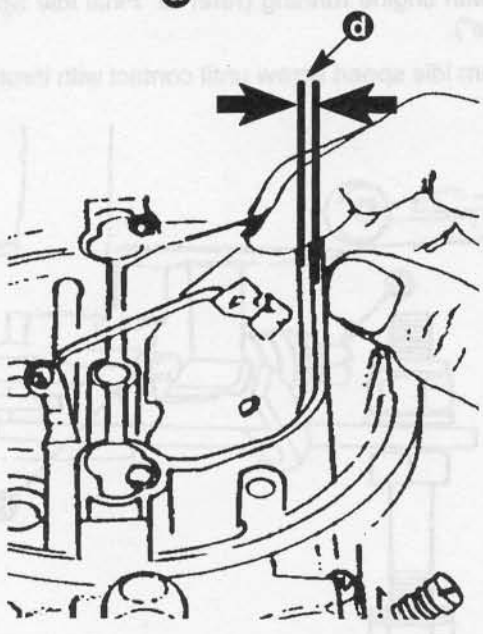
a - Bend Here

Choke Pull-Off

1. Choke Pull-Off is checked by holding in on vacuum diaphragm and attempting to close choke plate. The gap between the plate and housing is to be set at 1/8 in. (3.5mm).



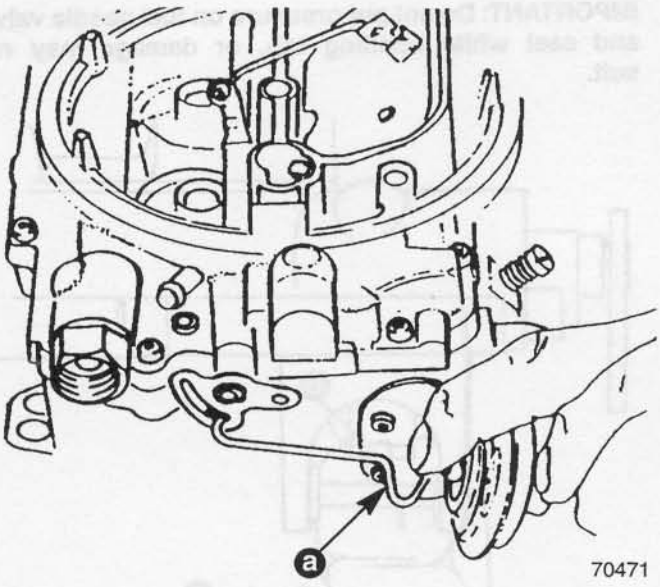
70471



70471

a - Vacuum Diaphragm
b - Choke Plate
c - Housing
d - Gap Measurement

2. Bend choke pull-off linkage to achieve setting given in previous step 1.

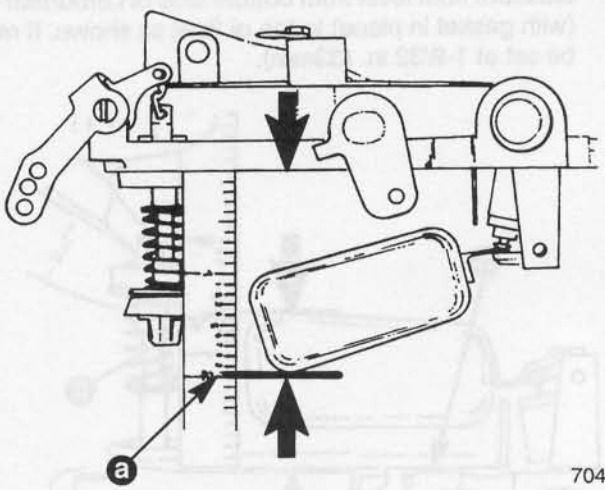


70471

a - Linkage (Bend)

Float Drop

1. Measure float drop from bottom side of carburetor top to toe of float (lowest part), as shown. It must be set at 2 in. (51mm).

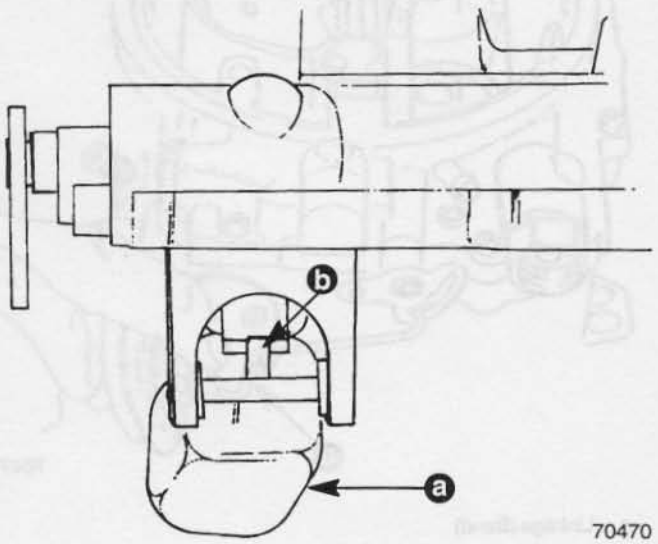


70469

a - Drop Measurement

2. If float drop is not correct, hold hinge pin firmly and bend tab shown, as needed.

IMPORTANT: Do not put pressure on fuel needle valve and seat while bending tab, or damage may result.

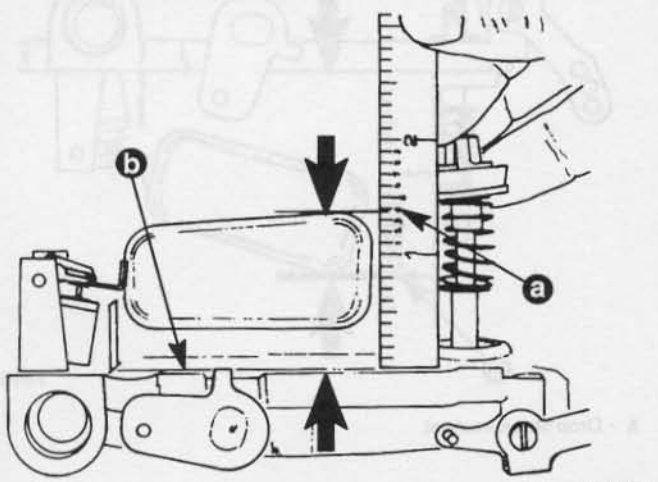


70470

a - Float
b - Tab (Bend)

Float Level

1. Measure float level from bottom side of carburetor top (with gasket in place) to toe of float as shown. It must be set at 1-9/32 in. (33mm).

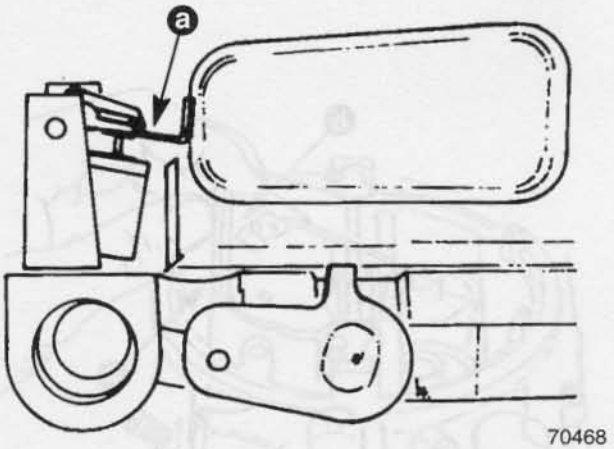


70468

a - Float Level Measurement
b - Gasket

2. If float level requires adjustment, hold hinge pin firmly and bend float arm shown, as needed.

IMPORTANT: Do not put pressure on fuel needle valve and seat while bending tab, or damage may result.



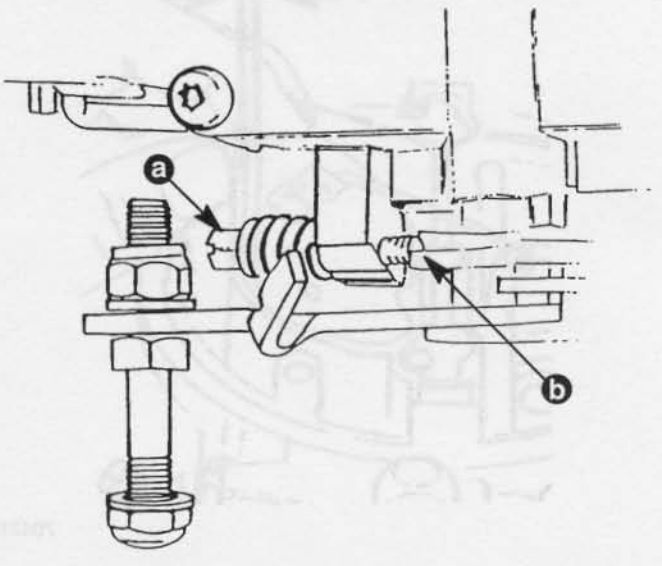
70468

a - Float Level Tab (Bend)

Preliminary Idle Speed and Mixture

Initial start settings are given following. Make final adjustment with engine running (refer to "Final Idle Speed and Mixture").

1. Turn idle speed screw until contact with throttle lever.

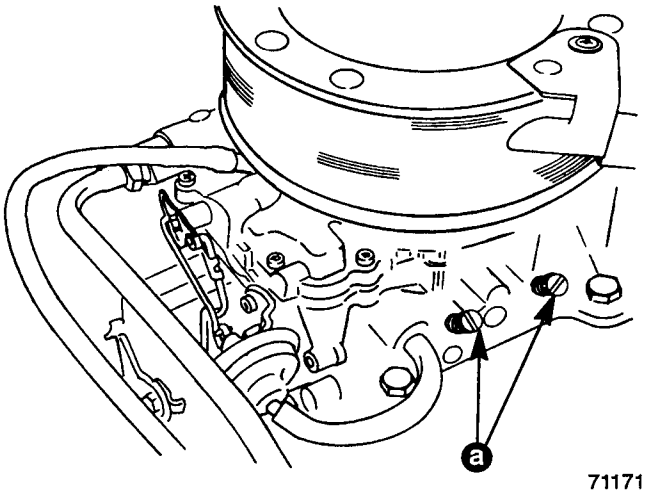


70474

a - Idle Speed Screw
b - Throttle Lever Contact Point

2. Turn idle mixture screws (needles) in (clockwise) until LIGHTLY seated then back out two to three turns.

IMPORTANT: Do not turn idle mixture screws tightly against seat, as damage to seat and/or needle may result.



71171

a - Idle Mixture Screws (Needles)

Final Idle Speed and Mixture

IMPORTANT: Boat MUST BE in the water and engine at normal operating temperature to accurately check and adjust idle speed and mixture.

Carburetor should be set so that engine idles as smoothly as possible, with boat in the water, engine normal operating temperature and drive unit in forward gear.

To adjust idle speed and mixture, proceed as follows:

IMPORTANT: DO NOT attempt to compensate for other engine problems (incorrect ignition timing, faulty ignition components, low compression, vacuum leaks, etc.) with carburetor adjustments. This will only cover the problem, which must be corrected if engine is to achieve maximum fuel economy and performance.

1. Connect a shop tachometer to engine.

IMPORTANT: DO NOT turn idle mixture screws (needles) tightly into seat, as damage to needle and/or seat may result.

2. If a new or rebuilt carburetor has been installed, turn each idle mixture screw until it LIGHTLY contacts seat (if not already accomplished), then back out 2 to 3 turns. This will provide a sufficient setting to allow starting the engine.
3. Start engine and run at 1500 RPM until engine reaches normal operating temperature.

⚠ WARNING

DO NOT leave helm unattended while performing idle speed and mixture adjustments, following. BE CAREFUL NOT TO ACCIDENTALLY ACCELERATE ENGINE WHILE PERFORMING ADJUSTMENTS.

4. With boat in open water, place remote control in forward gear, idle position.
5. Disconnect throttle cable barrel from anchor stud. BE SURE NOT TO LOSE SPACER ON ANCHOR STUD.
6. Adjust idle speed adjustment screw to obtain specified idle RPM. (Refer to SECTION 1B - MAINTENANCE, "Tune Up Specifications" charts.)

NOTE:Idle mixture screw adjustment will be ineffective if idle speed is too high.

7. With engine running at or just below specified idle RPM, adjust idle mixture screws as follows:
   a. Turn idle mixture needle in (clockwise) until the engine speed begins to decrease due to LEAN mixture.
   b. Turn same idle mixture screw outward (counterclockwise) until the engine speed begins to decrease due to a RICH mixture.
   c. Turn screw in to a point between these two extremes to obtain maximum engine smoothness and RPM.
   d. Repeat procedure with other mixture screw.
   e. Readjust idle speed adjusting screw, if necessary, to obtain specified idle RPM.
8. Place remote control in neutral. Turn ignition "OFF".
9. Refer to SECTION 2 - REMOVAL AND INSTALLATION; **install and adjust** throttle cable following instructions appropriate to your power package.

Repair

NOTICE

Refer to "Precautions" in this section BEFORE proceeding.

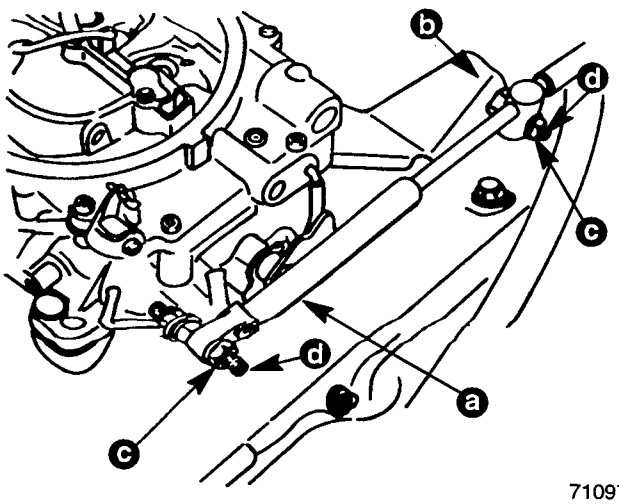
Removal

IMPORTANT: Carburetor malfunctions are, in many cases, caused by the presence of dirt, water or other foreign matter in carburetor. To aid in diagnosis, carefully remove carburetor from engine without draining fuel from bowl. Contents of fuel bowl may, then, be inspected for contamination as carburetor is disassembled.

1. Turn off fuel supply at fuel tank.
2. Remove carburetor cover. Remove crankcase ventilation hoses from flame arrestor; then, remove flame arrestor.

IMPORTANT: Place a clean cloth in bores of carburetor to prevent dirt and foreign material from falling into bores.

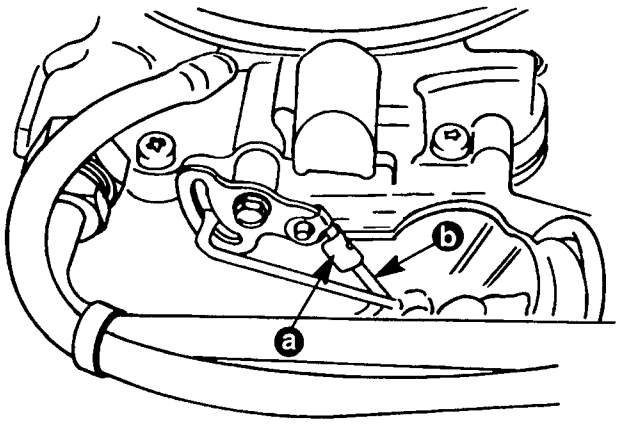
3. Disconnect throttle cable attaching hardware from throttle bracket and throttle lever anchor studs. Remove throttle cable.



71097

a - Throttle Cable
b - Bracket
c - Attaching Hardware
d - Anchor Studs

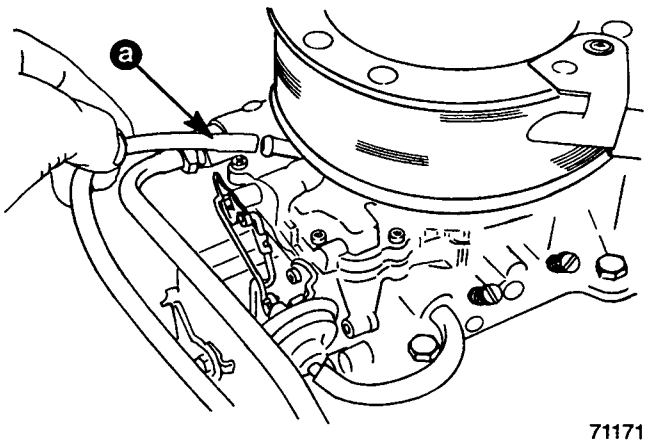
4. Disconnect retaining clip and choke linkage rod.



71096

a - Retaining Clip
b - Linkage Rod

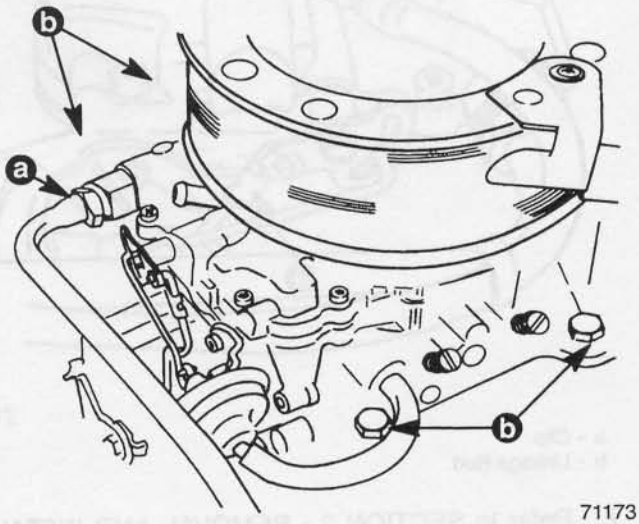
5. Disconnect fuel pump sight tube.



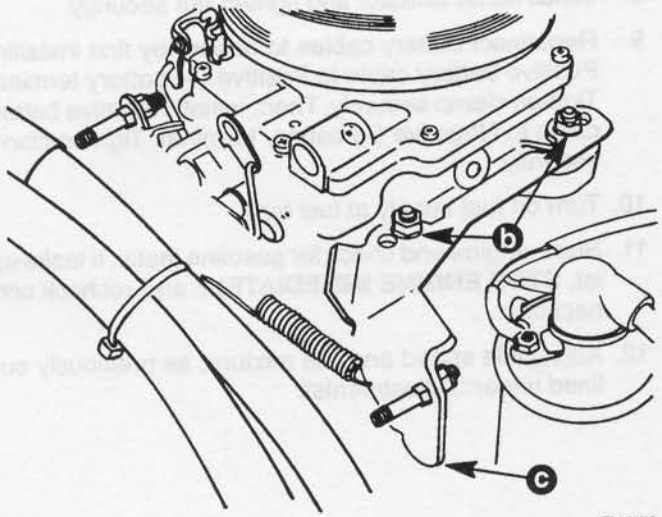
71171

a - Fuel Pump Sight Tube

6. Remove fuel line and carburetor attaching hardware. Remove carburetor and throttle bracket.



71173



71172

a - Fuel Line
b - Attaching Hardware
c - Throttle Bracket

7. Remove and discard old gaskets from carburetor, adaptor/wedge plate (if so equipped) and manifold.
8. Place a clean cloth over intake mainfold openings.

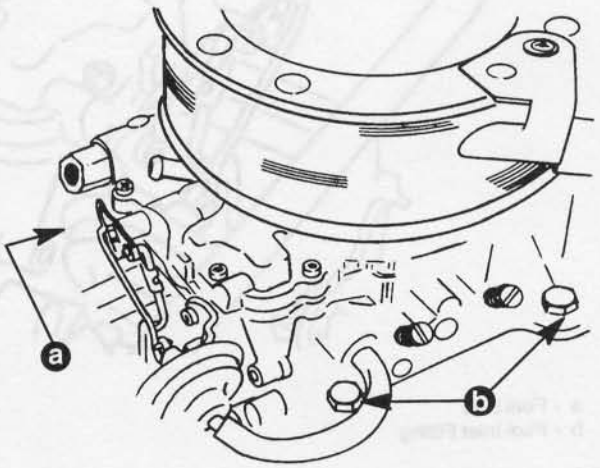
IMPORTANT: Covering intake manifold avoids entry of dirt or foreign material through openings.

Installation

1. Place new gasket on intake manifold.
2. If so equipped, install adaptor or wedge plate, depending on model. Place new gasket on top.

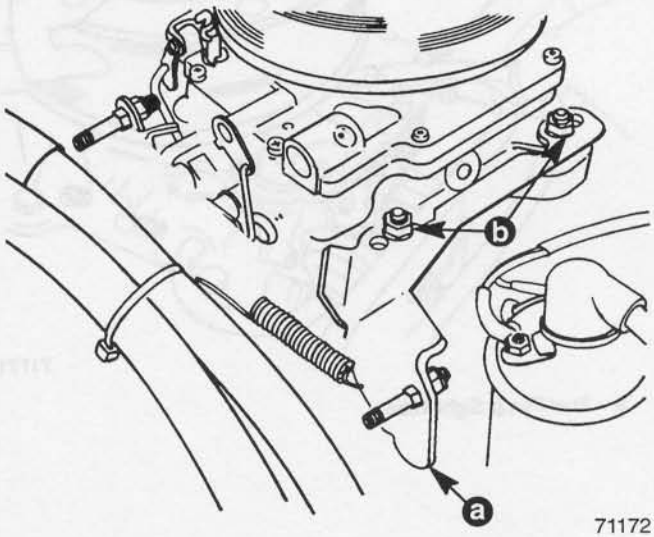
IMPORTANT: Carburetor is calibrated for use with an adaptor or wedge plate if the model was originally so equipped. Be certain to install adaptor or wedge plate if present upon disassembly.

3. Install carburetor and throttle bracket with attaching hardware. Torque fasteners to 132 lb.in. (15 N·m).



71173

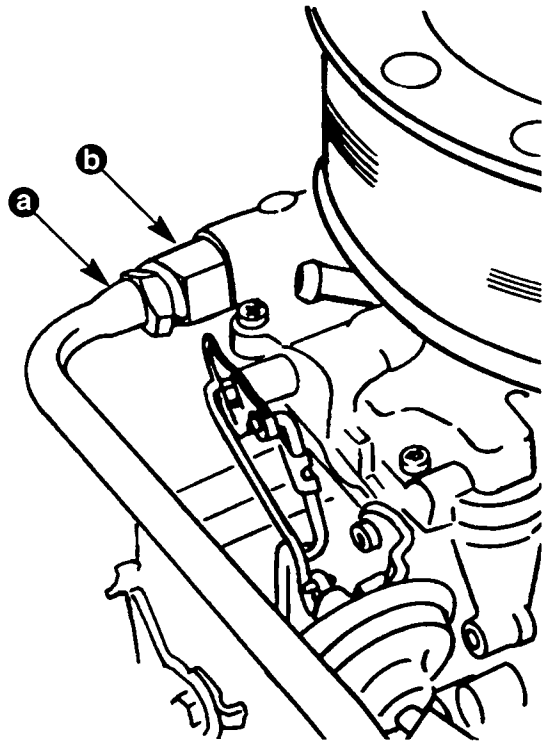
a - Throttle Bracket (Not Visible In This View)
b - Attaching Hardware



71172

a - Throttle Bracket
b - Attaching Hardware

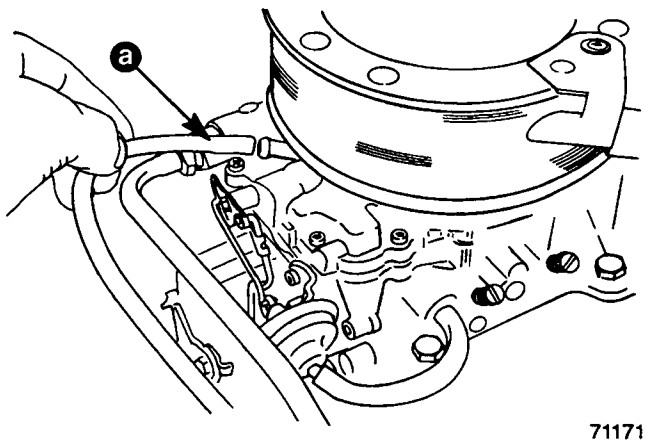
4. Install fuel line. Torque to 18 lb.ft. (24 N·m), while holding fuel inlet fitting with a suitable wrench.



71173

a - Fuel Line
b - Fuel Inlet Fitting

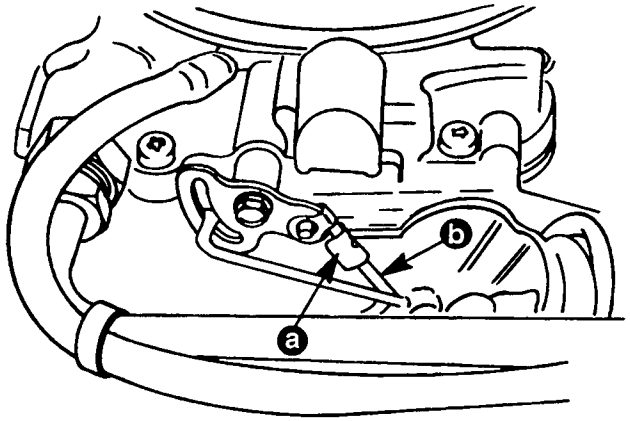
5. Connect fuel pump sight tube.



71171

a - Fuel Pump Sight Tube

6. Connect choke linkage rod and install retaining clip.

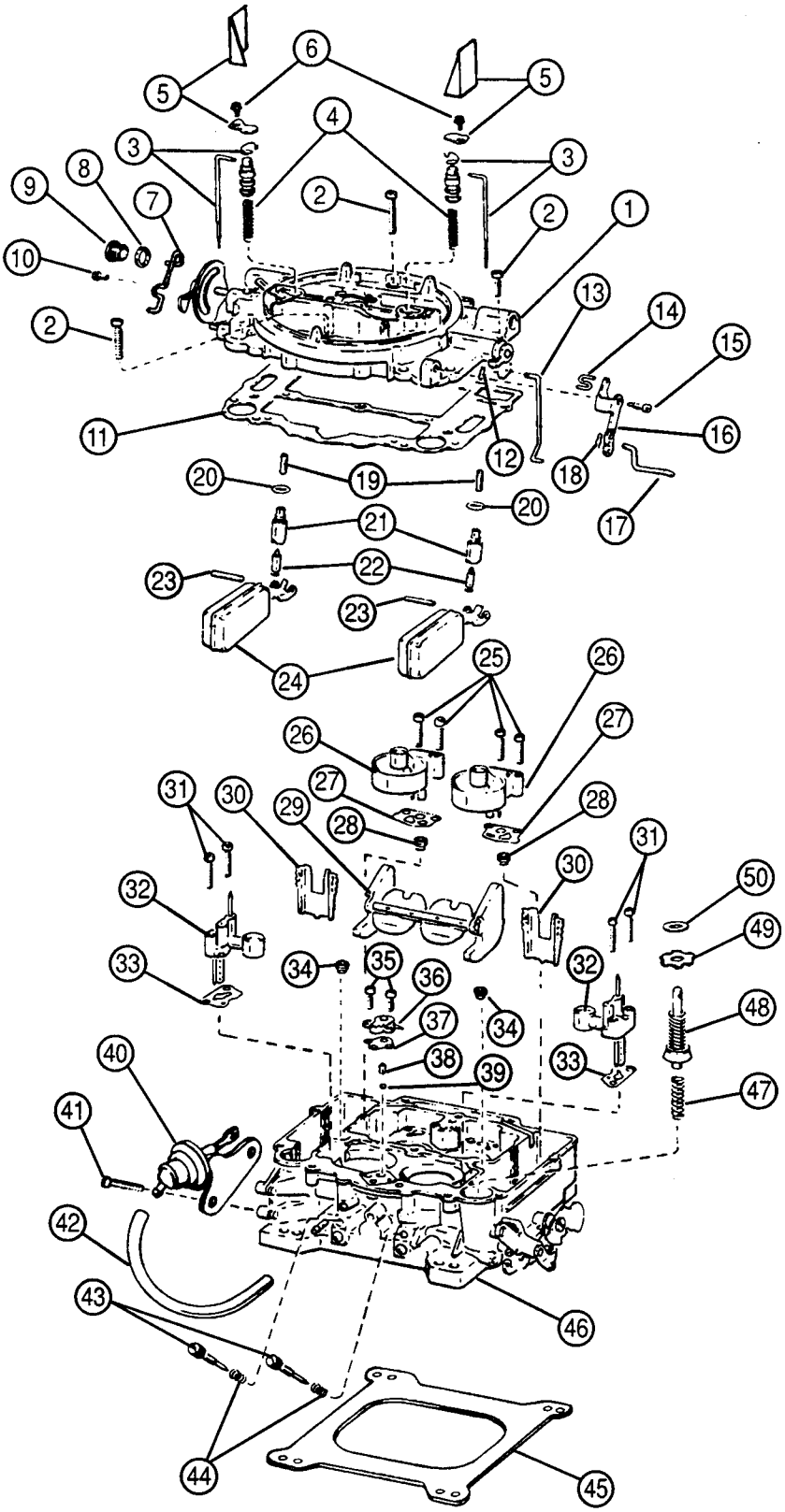


71096

a - Clip
b - Linkage Rod

7. Refer to SECTION 2 - REMOVAL AND INSTALLATION; **install and adjust** throttle cable following instructions appropriate to your power package.
8. Install flame arrestor and tighten nut securely.
9. Reconnect battery cables to battery by first installing Positive battery cable to Positive (+) battery terminal. Tighten clamp securely. Then, install Negative battery cable to Negative (–) battery terminal. Tighten clamp securely.
10. Turn on fuel supply at fuel tank.
11. Start engine and check for gasoline leaks. If leaks exist, **STOP ENGINE IMMEDIATELY** and recheck connections.
12. Adjust idle speed and idle mixture, as previously outlined under "Adjustments".

Exploded View



1 - Air Horn (Carburetor Top)
2 - Screw
3 - Metering Rod Assembly
4 - Spring, Metering Rod
5 - Cover (With Air Deflector), Metering Rod
6 - Screw
7 - Linkage Rod, Choke-Pull Off
8 - Sealing Washer
9 - Fuel Inlet Fitting
10- Screw
11- Gasket
12- Wire Clip
13- Linkage Rod, Choke Plate
14- "S"-Shaped Link
15- Screw
16- Accelerator Pump Lever
17- Linkage Rod, Accelerator Pump
18- Wire Clip
19- Filter, Fuel Inlet
20- Gasket
21- Seat, Fuel Inlet
22- Needle Valve, Fuel Inlet
23- Pin
24- Float
25- Screw
26- Secondary Venturi Cluster
27- Gasket
28- Jet, Secondary Fuel
29- Auxiliary Air Valve and Weight Assembly
30- Baffle Plate, Float Bowl
31- Screw
32- Primary Venturi Cluster
33- Gasket
34- Jet, Primary Fuel
35- Screw
36- Fuel Pump Injector Housing
37- Gasket
38- Check-Weight (Or Check-Spring, If So Equipped)
39- Check-Ball
40- Diaphragm, Choke-Pull Off
41- Screw
42- Vacuum Hose
43- Idle Mixture Screw
44- Spring, Idle Mixture Screw
45- Gasket, Carburetor Base
46- Float Bowl/Body (Carburetor Bottom)
47- Spring, Accelerator Pump
48- Accelerator Pump
49- Plunger Guide
50- Plunger Washer

71327

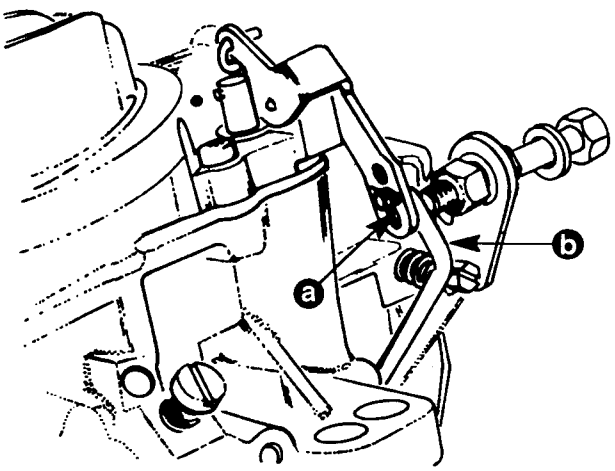
Weber Carburetor

Disassembly

The following is a step-by-step procedure for completely overhauling carburetor after removed from engine. In many cases, however, complete overhaul is not necessary and, in these cases, only the steps required to repair the carburetor malfunction should be performed. Read the instructions carefully to prevent doing unnecessary steps.

IMPORTANT: Before performing any service on carburetor, it is essential that carburetor be placed in a holding fixture to prevent possible damage to throttle valves.

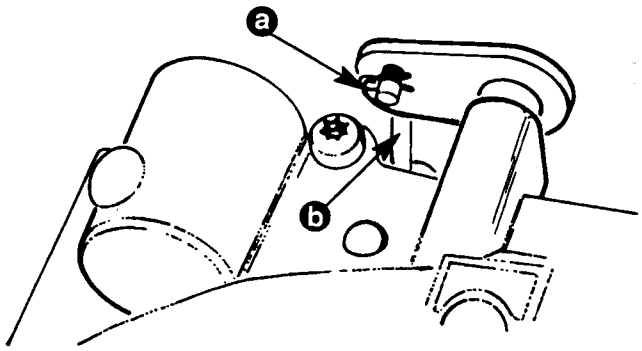
1. Remove wire clip to disconnect accelerator pump linkage.



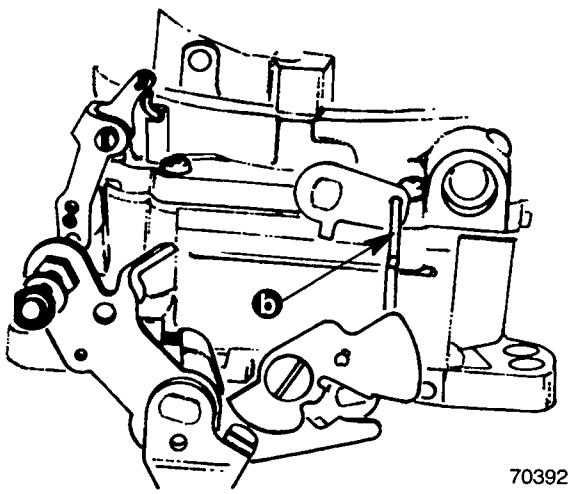
70390

a - Wire Clip
b - Accelerator Pump Linkage Rod

2. Remove wire clip to disconnect choke plate linkage.



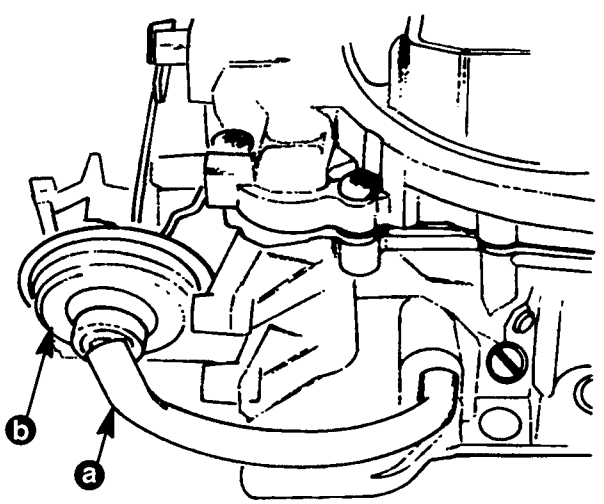
70391



70392

a - Wire Clip
b - Choke Plate Linkage Rod

3. Disconnect vacuum hose from choke pull-off diaphram.

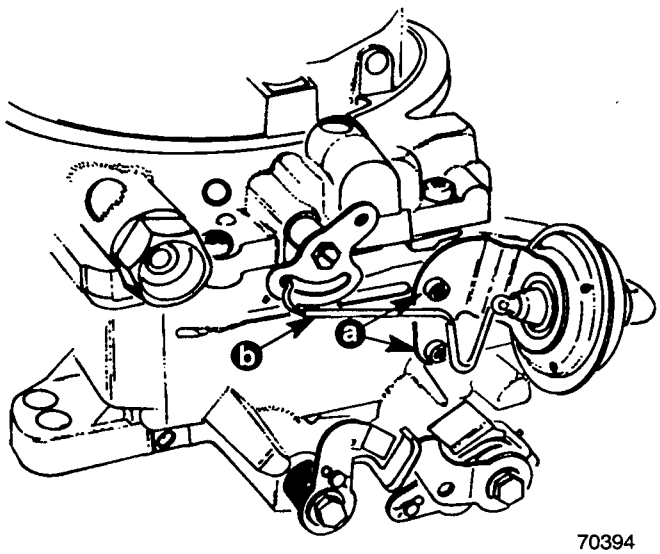


70393

a - Vacuum Hose
b - Choke Pull-Off Diaphram

4. Remove screws from choke pull-off diaphram bracket to disengage choke pull-off linkage.

NOTE:Depending on amount of service required, it may not be necessary to remove diaphram and bracket.

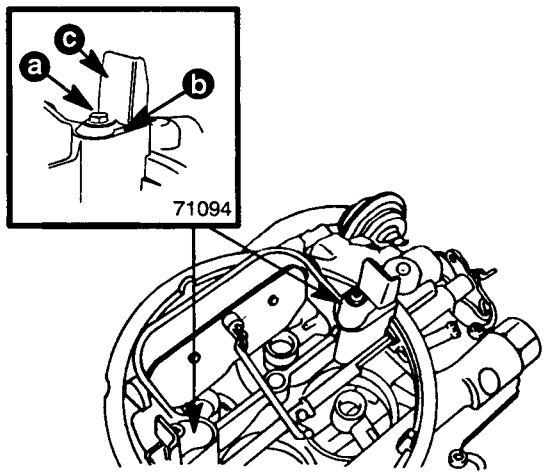


70394

a - Screws
b - Linkage Rod

IMPORTANT: Metering rods should always be removed before seperating top and bottom halves of carburetor.

5. Loosen (not necessary to remove, depending on amount of service required) metering rod cover screws. Turn cover, or remove, to expose metering rod.

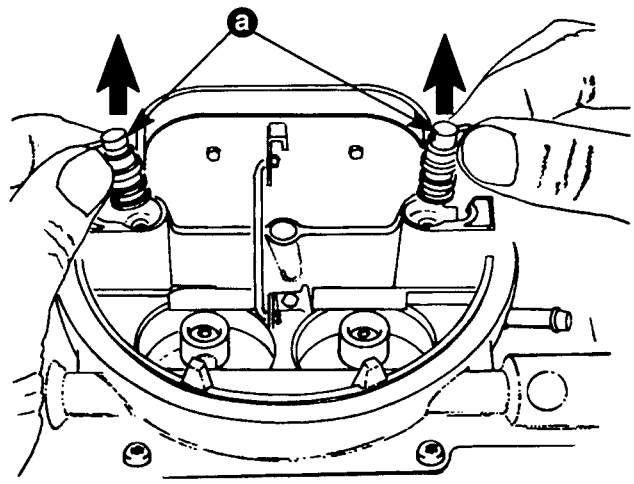


71095

a - Screws
b - Metering Rod Cover(s)
c - Air Deflectors (If So Equipped)

IMPORTANT: Be careful not to mix metering rods when removing them.

6. Carefully lift metering rod assemblies straight out.

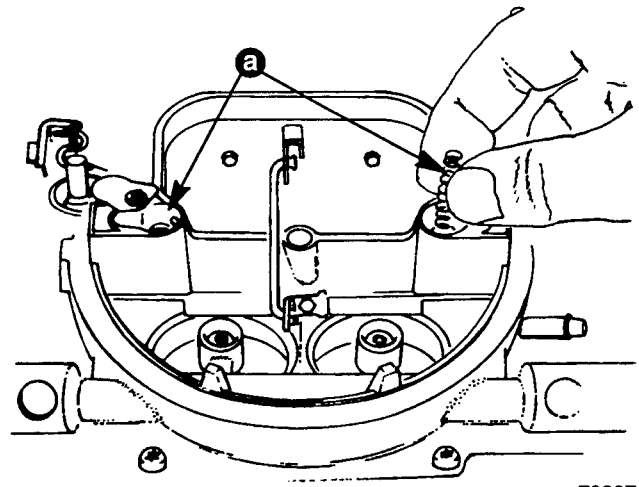


70396

a - Metering Rod Assembly(s)

7. Remove metering rod springs.

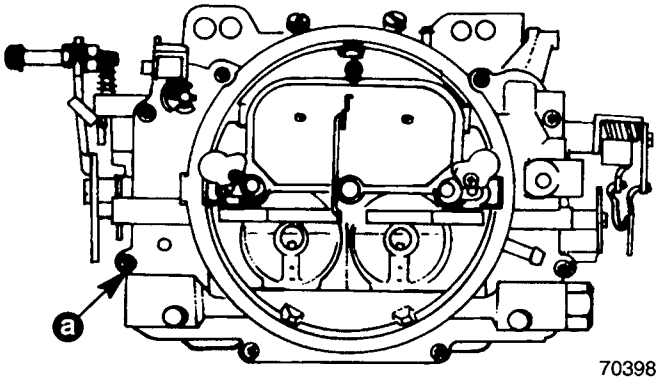
IMPORTANT: Metering rod springs are color coded and should not be interchanged with other carburetors.



70397

a - Spring(s)

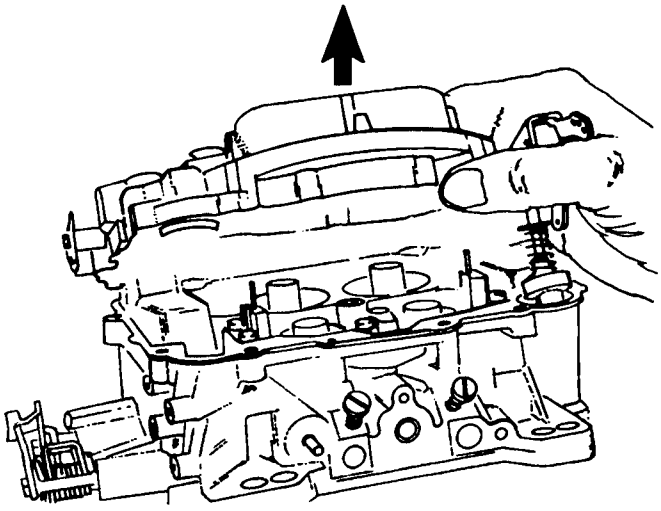
8. Remove screws (9) to separate top and bottom halves of carburetor.



70398

a - Screw(s)

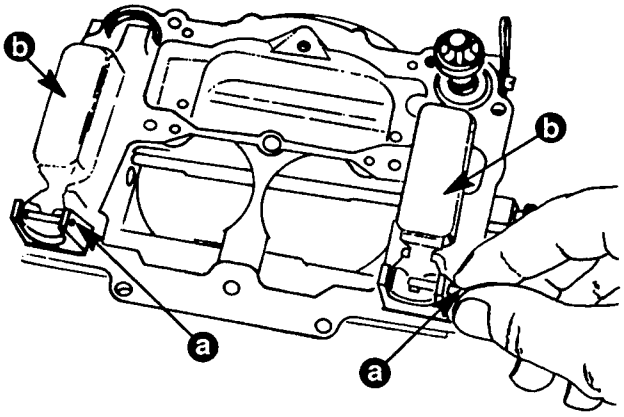
9. Carefully lift off carburetor top.



70399

10. Slide pin out to remove the float.

IMPORTANT: Be careful not to mix up floats after removal.

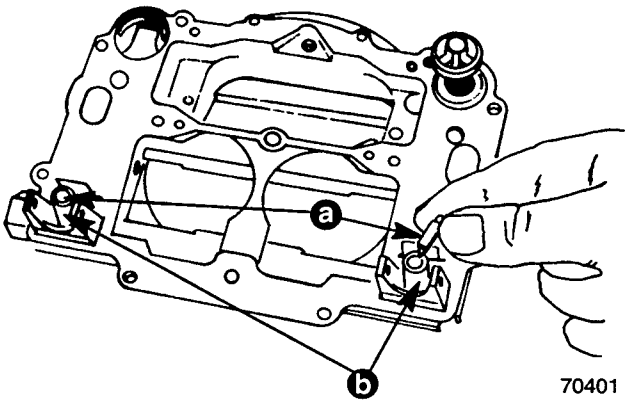


70400

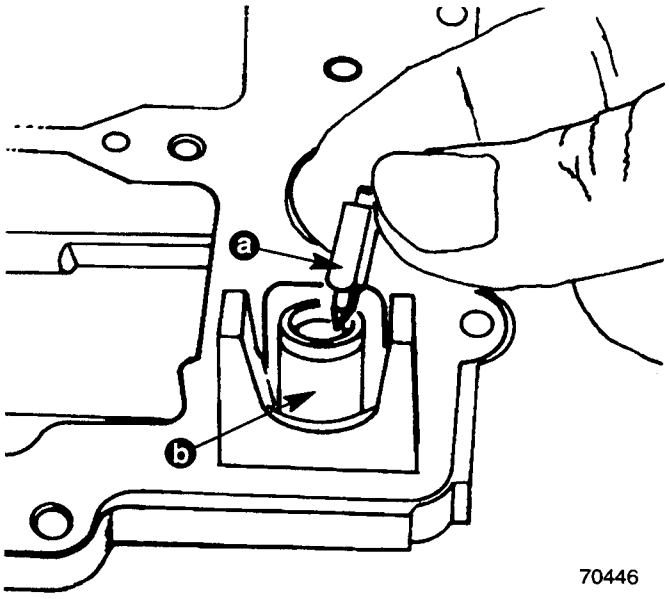
a - Pin(s)
b - Float(s)

11. Remove inlet needle from seat.

IMPORTANT: Be careful not to mix up inlet needles and seats after removal.



70401

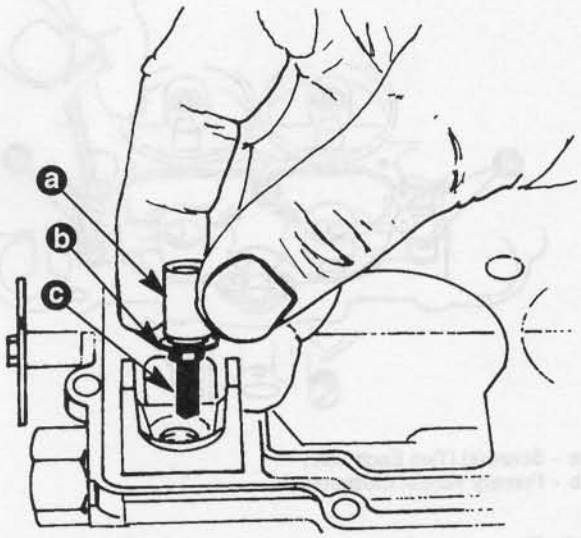


70446

a - Inlet Needle(s)
b - Seat(s)

12. Remove seat, gasket, and inlet filter.

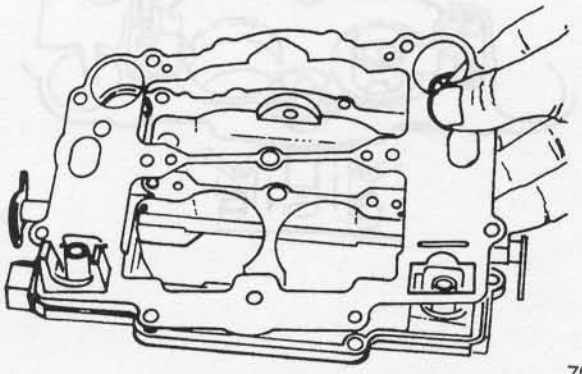
IMPORTANT: Be careful not to mix up seats after removal.



70447

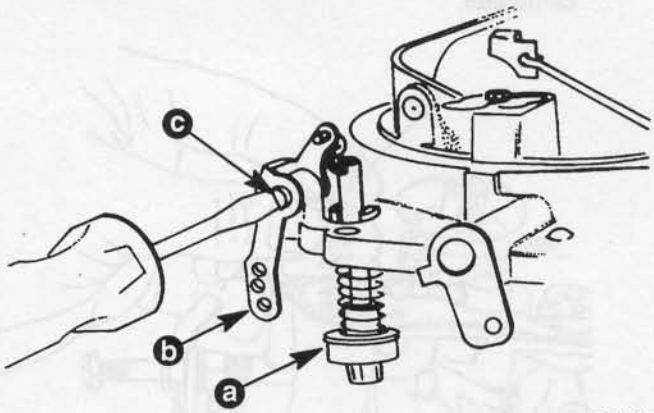
a - Seat
b - Gasket
c - Inlet Filter

13. Remove gasket from top of carburetor.



70448

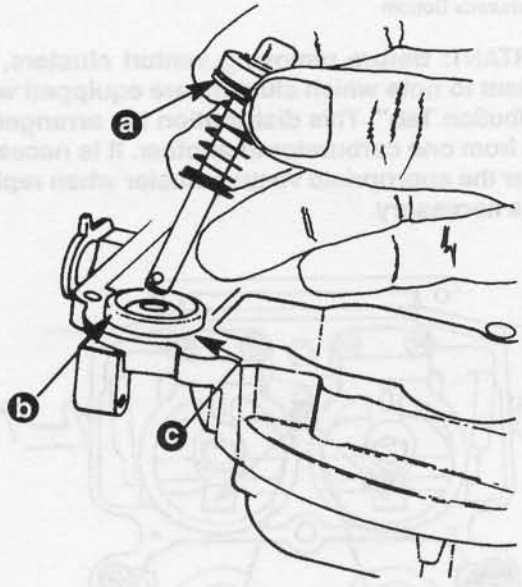
14. Remove accelerator pump lever.



70449

a - Accelerator Pump
b - Accelerator Pump Lever
c - Retaining Screw

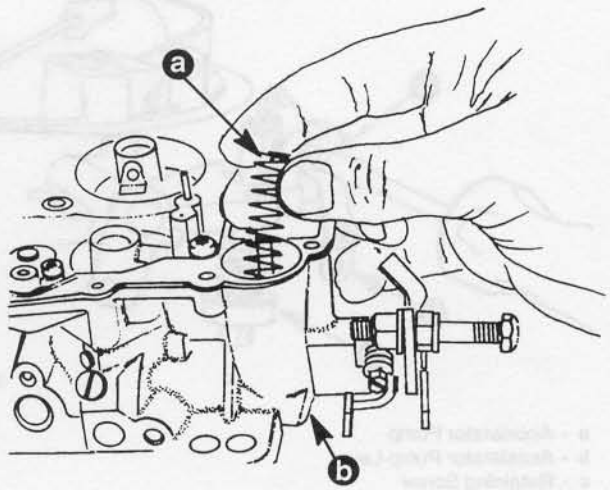
15. Remove accelerator pump.



70450

a - Accelerator Pump
b - Plunger Guide
c - Plunger Washer (Not Visible In This View)

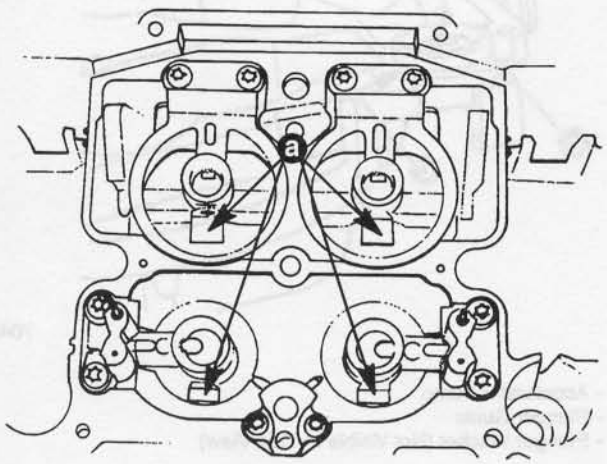
16. Remove accelerator pump spring from bottom half of carburetor.



70451

a - Accelerator Pump Spring
b - Carburetor Bottom

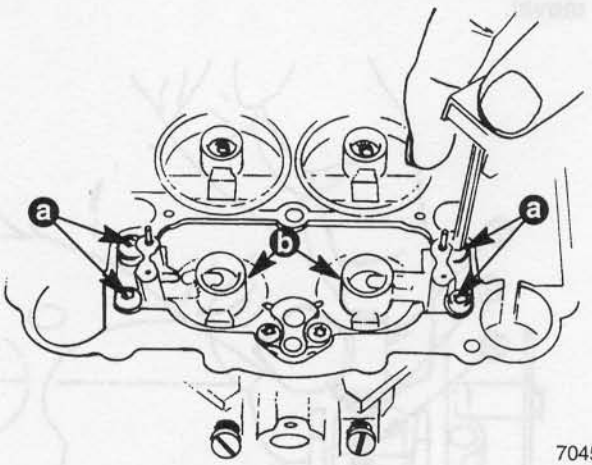
IMPORTANT: Before removing venturi clusters, it is important to note which clusters are equipped with a "Distribution Tab". This distribution tab arrangement varies from one carburetor to another. It is necessary to order the appropriate venturi cluster when replacement is necessary.



70452

a - Distribution Tab(s) (Location and Total Number May Vary)

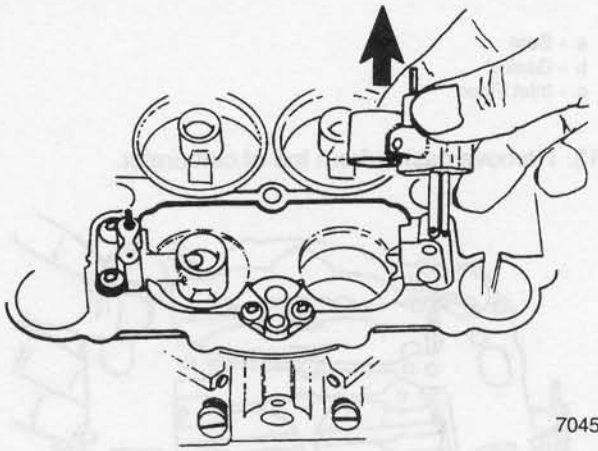
17. Remove screws (2) that secure primary venturi cluster.



70453

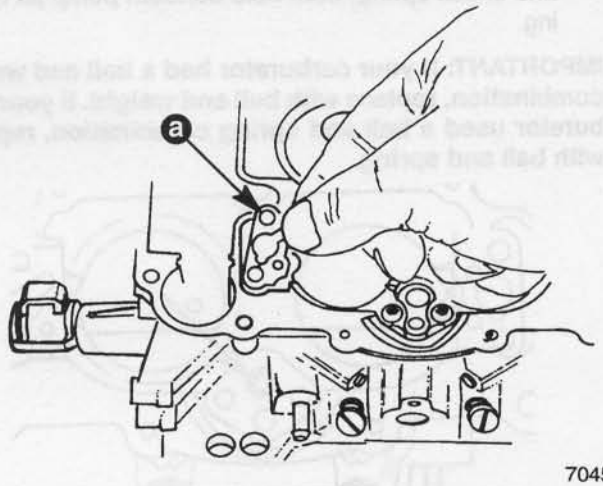
a - Screw(s) (Two Each Side)
b - Primary Venturi Cluster(s)

18. Remove primary venturi cluster by lifting straight up.



70454

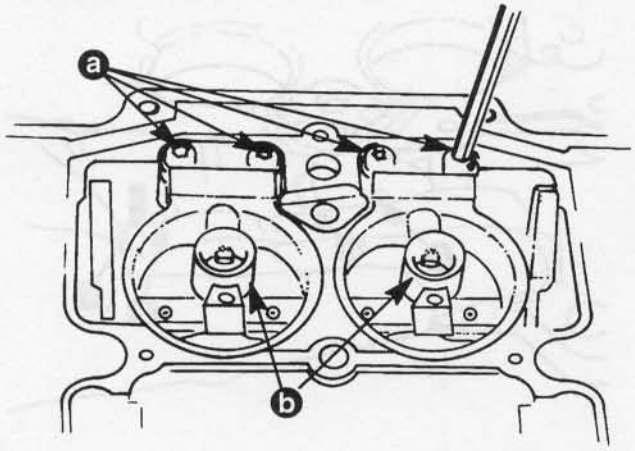
19. Remove gasket from beneath venturi cluster.



70455

a - Gasket, Primary Venturi Cluster

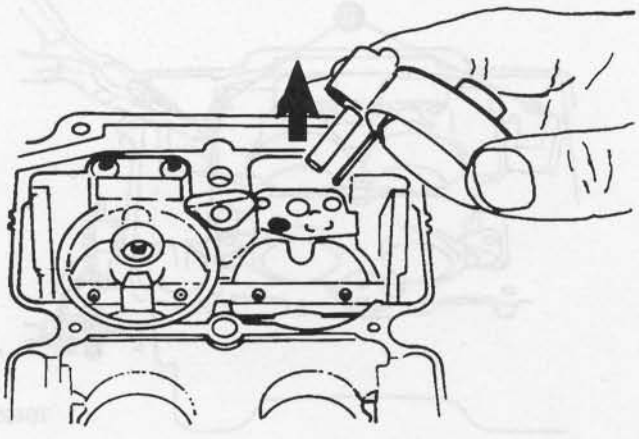
20. Remove screws (2) that secure secondary venturi clusters.



70456

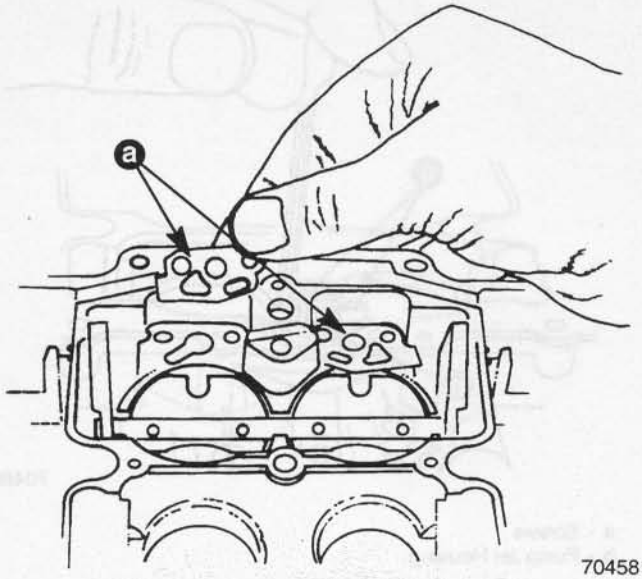
a - Screw(s) (Two Each Side)
b - Secondary Venturi Cluster(s)

21. Remove secondary venturi cluster by lifting it straight up.



70457

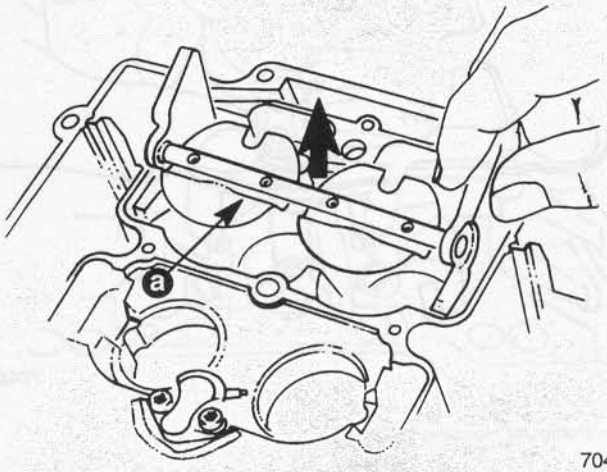
22. Remove gaskets from beneath secondary venturi clusters.



70458

a - Gasket, Secondary Venturi Cluster

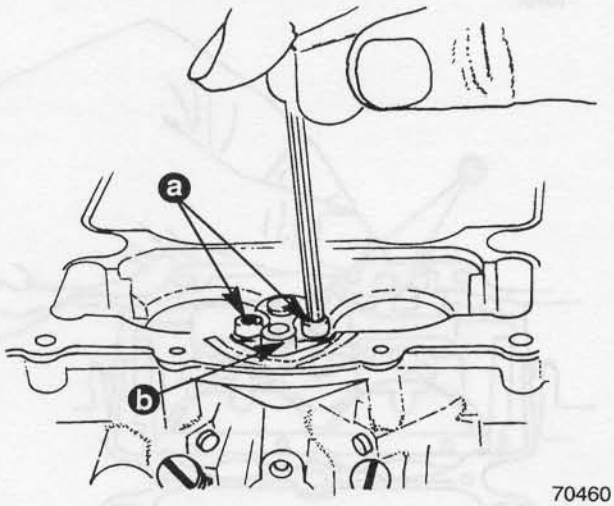
23. Remove auxiliary air valve and weight assembly by lifting it straight out.



70459

a - Auxiliary Air Valve and Weight Assembly

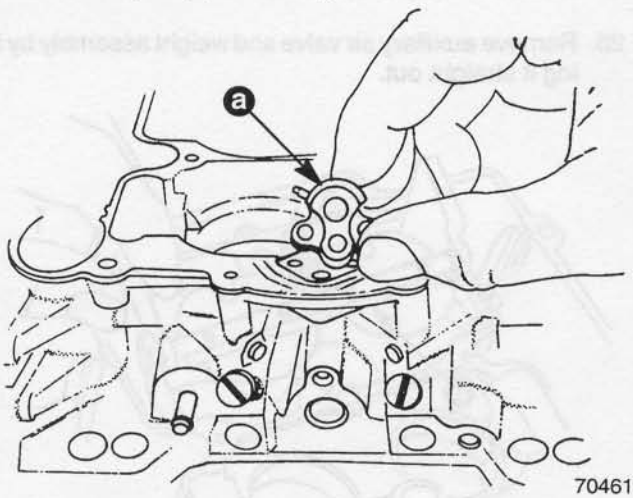
24. Remove screws (2) that secure pump jet housing.



70460

a - Screws
b - Pump Jet Housing

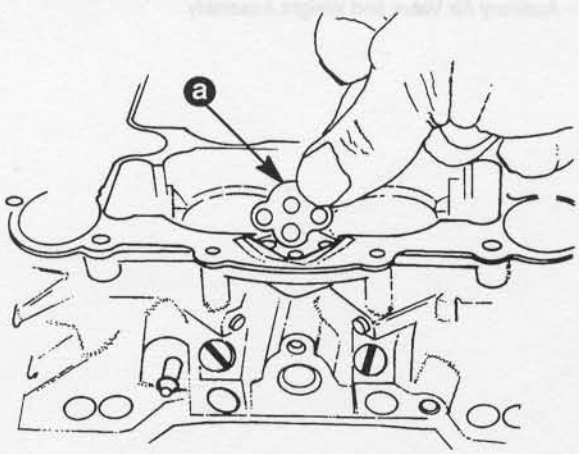
25. Remove pump jet housing.



70461

a - Pump Jet Housing

26. Remove gasket from beneath pump jet housing.

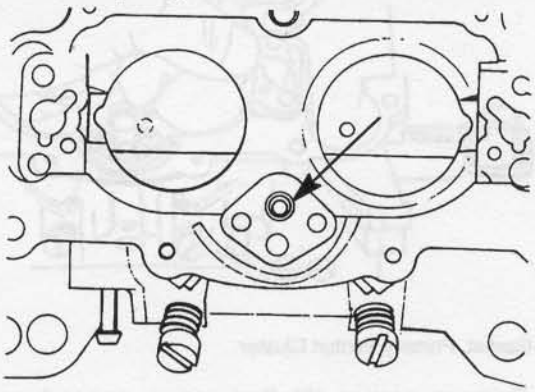


70462

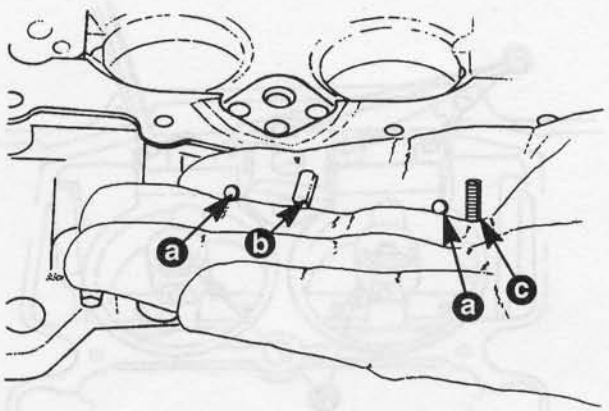
a - Gasket, Pump Jet Housing

27. Remove check-ball and check-weight, or check-ball and check-spring, from hole beneath pump jet housing.

IMPORTANT: If your carburetor had a ball and weight combination, replace with ball and weight. If your carburetor used a ball and spring combination, replace with ball and spring.



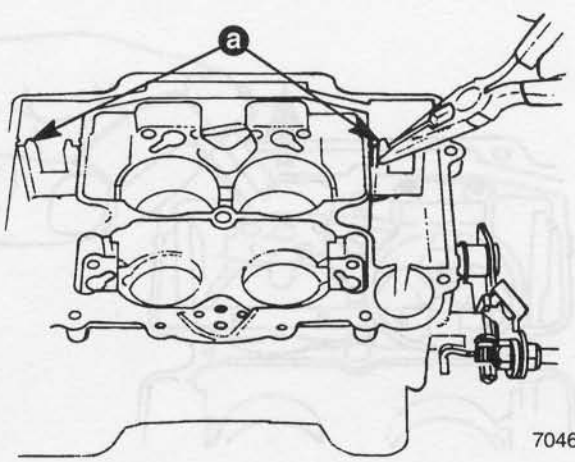
70463



70464

a - Check-Ball
b - Check-Weight
c - Check-Spring

28. Remove float bowl baffle plates.

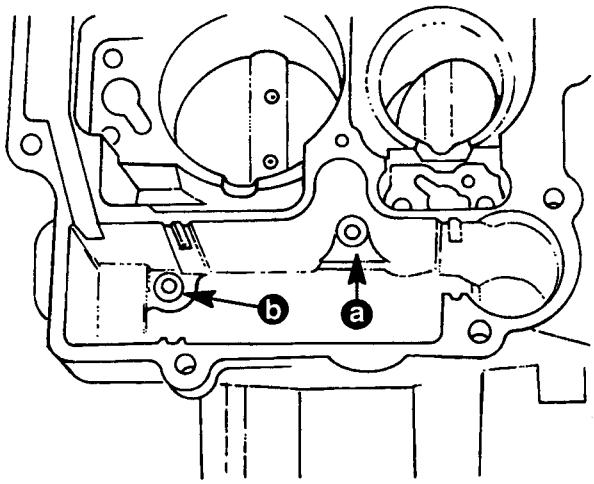


70465

a - Baffle Plate

IMPORTANT: Do not mix up the primary and secondary jets. Make note of the jet sizes and their location before removal to be certain they are installed in the carburetor side from which they were removed, during reassembly.

29. Remove primary and secondary jets.

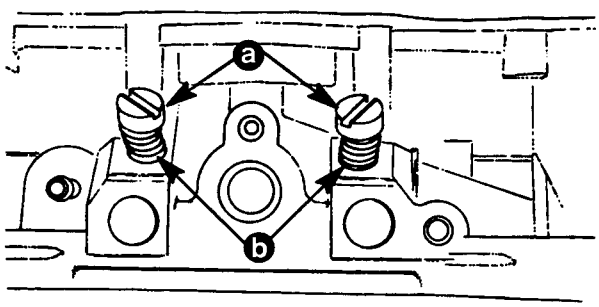


70466

a - Primary Fuel Jet
b - Secondary Fuel Jet

IMPORTANT: Before removing mixture screws, check and note the number of turns from the fully seated position. Also, do not mix up the two screws.

30. Remove mixture screws.



70467

a - Idle Mixture Screw
b - Spring, Idle Mixture Screw

Cleaning and Inspection

⚠CAUTION

Rubber, plastic parts, pump plungers or diaphragms cannot be immersed in carburetor cleaner.

⚠CAUTION

Avoid damage to carburetor. Do not leave carburetor in immersion-type cleaner for more than two hours.

IMPORTANT: Do not immerse metering rod springs in carburetor cleaner; the color, if not "natural" metal, may be removed. Clean separately as needed.

1. Clean metal carburetor parts in a commercial, immersion-type cleaner, until all deposits have been removed. Follow manufacturer's instructions of cleaner being used for proper cleaning and rinsing procedures.

⚠CAUTION

Avoid personal injury. Always wear safety-glasses when using compressed air.

2. Blow out passages with compressed air. Do not drill through passages.

IMPORTANT: DO NOT use a wire or drill to clean jets, passages, or tubes in carburetor, as this may enlarge orifices and seriously affect carburetor calibration.

3. Wipe all parts, that cannot be cleaned in immersion cleaner, with a clean, dry cloth .
4. Carefully inspect all carburetor parts for damage or wear; pay particular attention to the following:
   a. **Idle mixture screws** - Replace if damaged or worn.
   b. **Fuel inlet needle valve and seat** - Replace with new needle and seat if worn or damaged.
   c. **Casting surfaces** - Inspect accelerator pump plunger well for scoring or deposits. Replace worn or corroded components.
   d. **All linkage rods and levers** - Replace if worn or damaged.
   e. **Accelerator pump and plunger parts** - Replace pump and parts if worn or damaged.
   f. **Float assembly and hinge pin** - Float weight of each should be the same. Replace either if fuel can be heard inside when shaken. Check hinge pin and holes for wear. Replace components if worn or defective.
   g. **Throttle valves and shafts** - Check for binding (through entire operating range, making sure valves open and close completely) or for looseness in carburetor body.

IMPORTANT: DO NOT remove throttle valves. If any of the throttle parts or float bowl/carburetor body shaft bores are found to be worn or damaged, carburetor replacement is required.

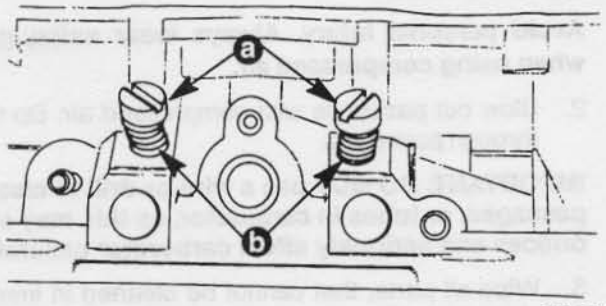
   h. **Choke valve and shaft/lever assembly** - Check shaft and lever for excessive looseness in air horn. Check choke valve and shaft/lever assembly for binding, through entire operating range. Air horn assembly must be replaced if choke valve and shaft/lever are worn.

5. Check that choke-pull off diaphragm plunger retracts when vacuum is applied to unit, and that it holds vacuum (plunger remains seated if vacuum is maintained).

Reassembly

1. Install mixture screws (needles) with springs in place. Turn idle mixture screws in (clockwise) until LIGHTLY seated then back out two to three turns, if previous settings were not noted on disassembly.

IMPORTANT: Do not turn idle mixture screws tightly against seat, as damage to seat and/or needle may result.

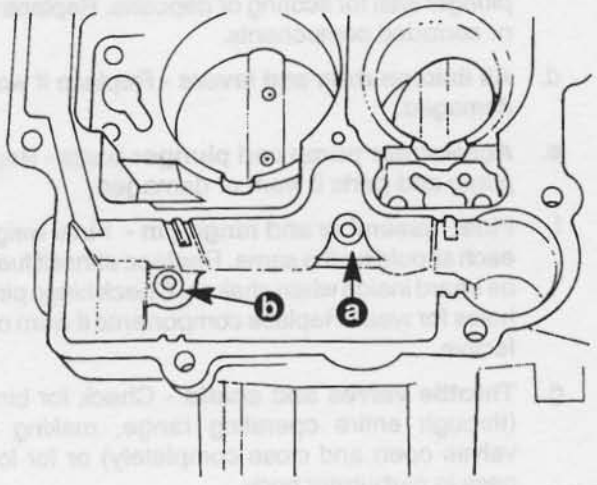


70467

a - Idle Mixture Screw
b - Spring, Idle Mixture Screw

2. Install the primary and secondary jets.

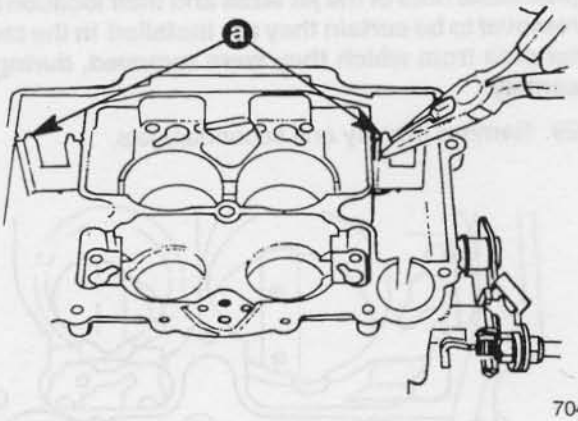
IMPORTANT: Be sure that primary and secondary jets are installed in the appropriate location. Be sure that the size matches the same size recorded during disassembly.



70466

a - Primary Fuel Jet
b - Secondary Fuel Jet

3. Install the float bowl baffle plates.

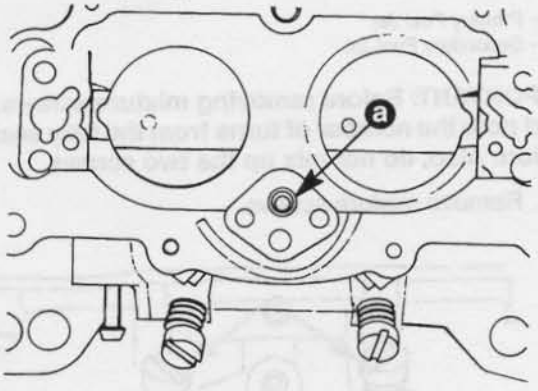


70465

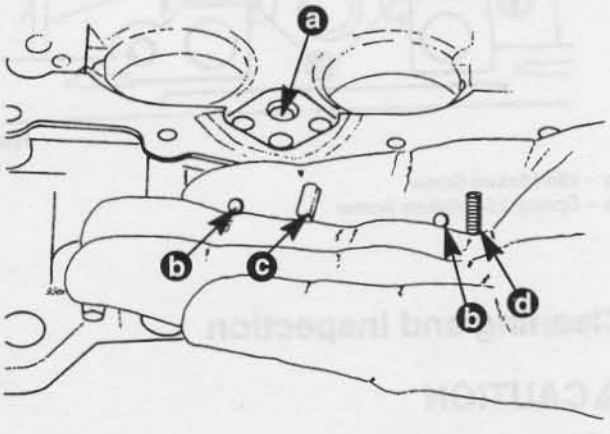
a - Baffle Plate

4. Into bore beneath pump jet housing location, install check-ball and then, check-weight, or if so equipped, check-ball and check-spring.

IMPORTANT: If your carburetor had a ball and weight combination, replace with ball and weight. If your carburetor used a ball and spring combination, replace with ball and spring.



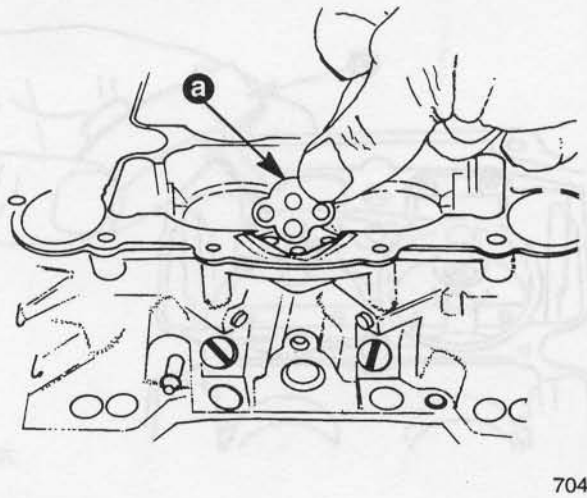
70463



70464

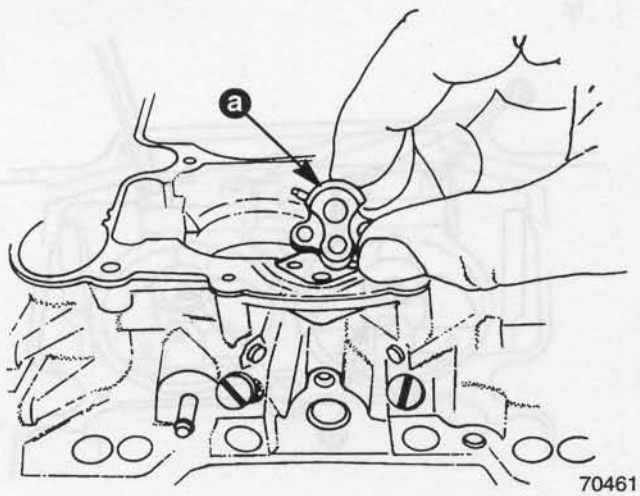
a - Bore
b - Check-Ball
c - Check-Weight
d - Check-Spring

5. Position pump jet housing gasket.



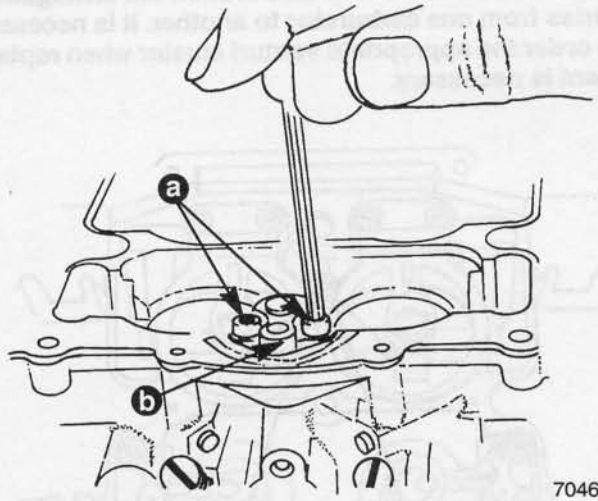
a - Gasket, Pump Jet Housing

6. Install pump jet housing.



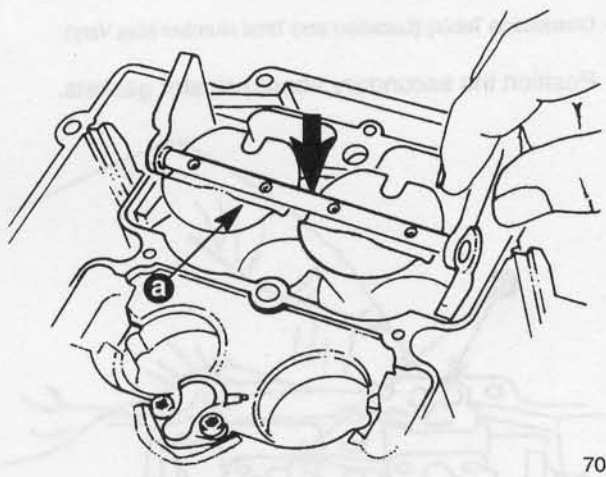
a - Pump Jet Housing

7. Install screws (2) that secure pump jet housing. Tighten securely.



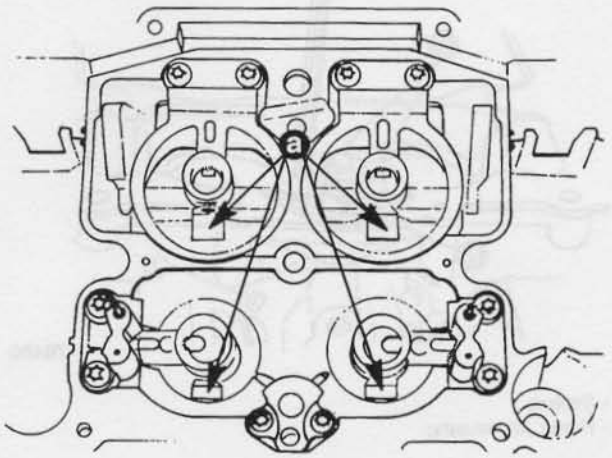
a - Screws
b - Pump Jet Housing

8. Install the auxiliary air valve and weight assembly.



a - Auxilary Air Valve and Weight Assembly

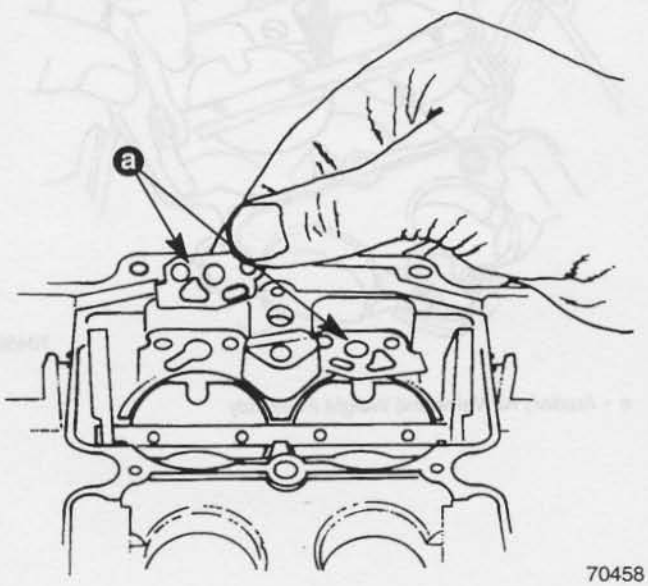
IMPORTANT: Before installing venturi clusters, it is important to note which clusters were equipped with a "Distribution Tab". This distribution tab arrangement varies from one carburetor to another. It is necessary to order the appropriate venturi cluster when replacement is necessary.



70452

a - Distribution Tab(s) (Location and Total Number May Vary)

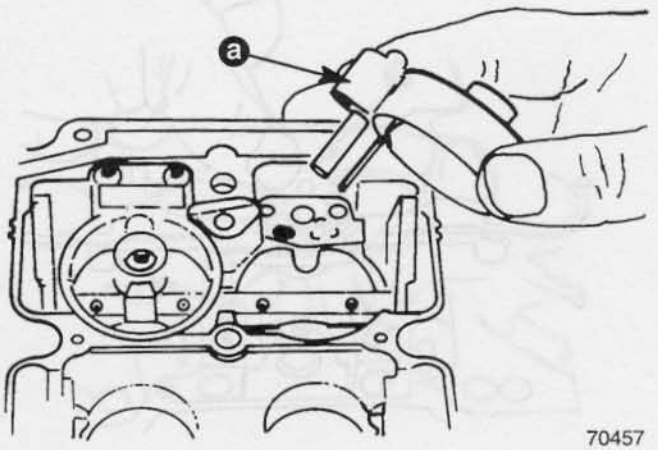
9. Position the secondary venturi cluster gaskets.



70458

a - Gasket, Secondary Venturi Cluster

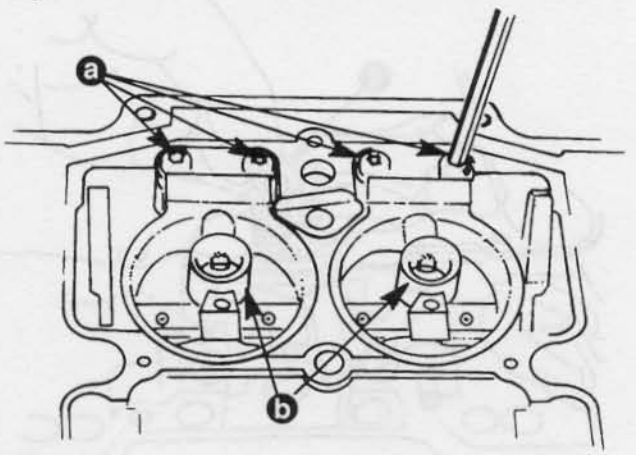
10. Install the secondary venturi clusters.



70457

a - Secondary Venturi Cluster

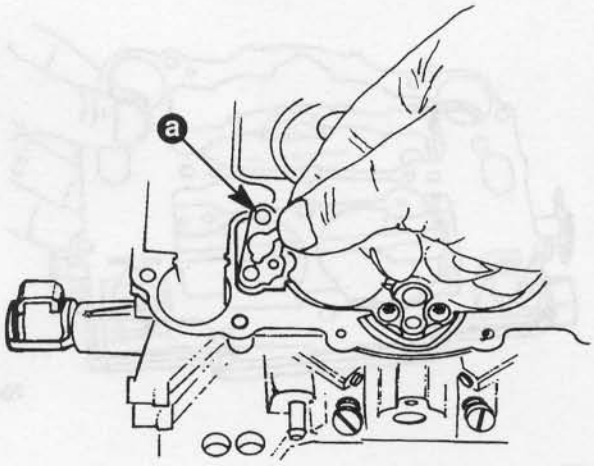
11. Secure each cluster with two screws. Tighten securely.



70456

a - Screws (Two Each Side)
b - Secondary Venturi Cluster(s)

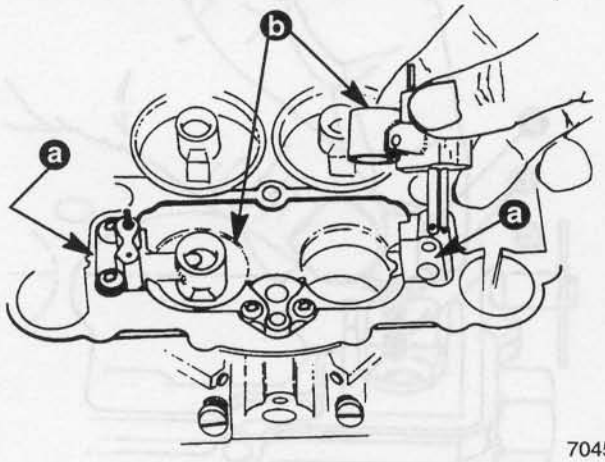
12. Position the primary venturi cluster gaskets.



70455

a - Gasket, Primary Venturi Cluster

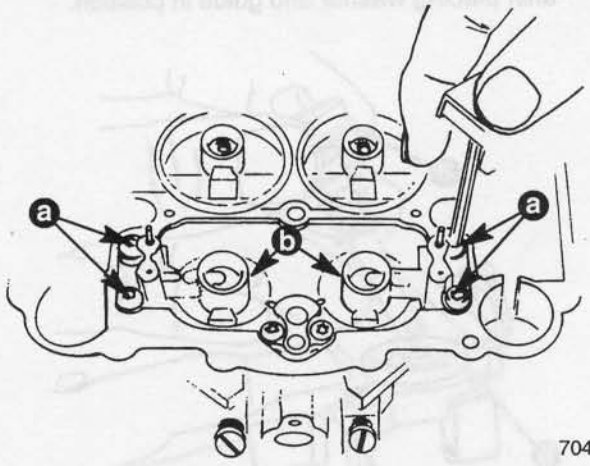
13. Install the primary venturi clusters.



70454

a - Gasket, Primary Venturi Cluster (One Not Visiable In This View)
b - Primary Venturi Cluster

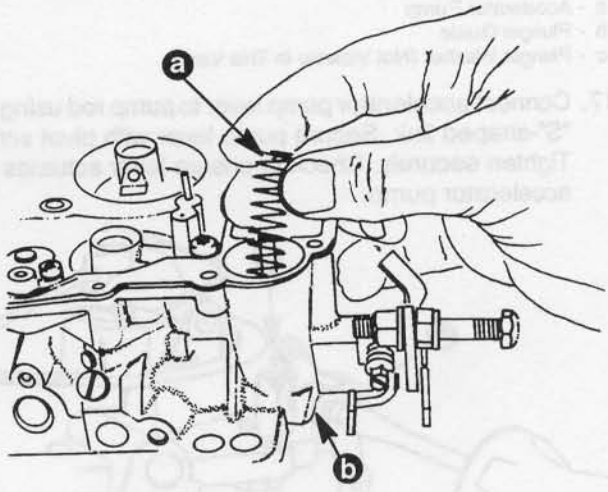
14. Secure each cluster with two screws. Tighten securely.



70453

a - Screws (Two Each Side)
b - Primary Venturi Cluster(s)

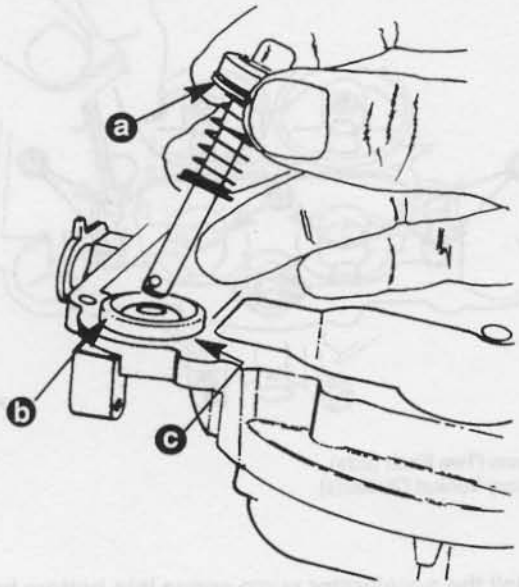
15. Install the accelerator pump spring into bottom half of carburetor.



70451

a - Accelerator Pump Spring
b - Carburetor Bottom

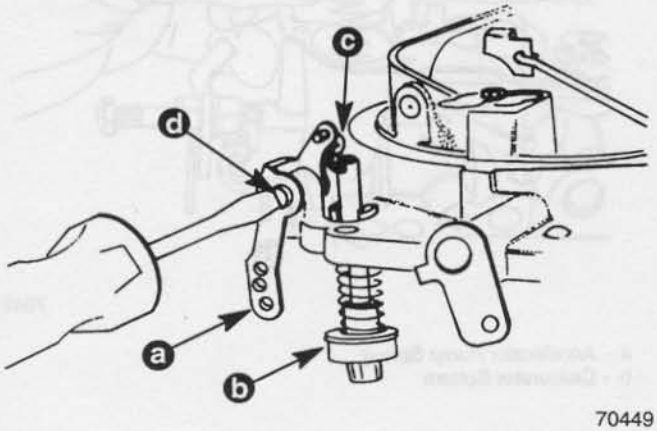
16. Install accelerator pump in top of carburetor housing, after placing washer and guide in position.



70450

a - Accelerator Pump
b - Plunger Guide
c - Plunger Washer (Not Visiable In This View)

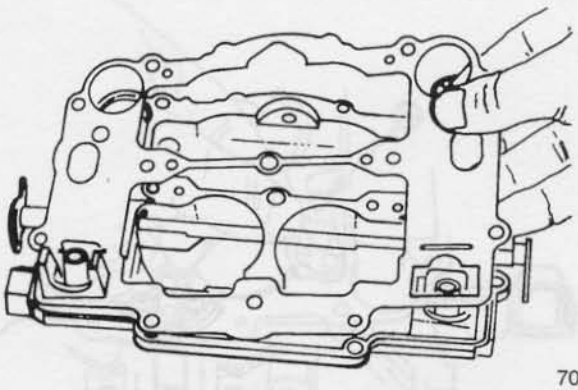
17. Connect accelerator pump lever to pump rod using the "S"-shaped link. Secure pump lever with pivot screw. Tighten securely. Check to ensure lever actuates the accelerator pump.



70449

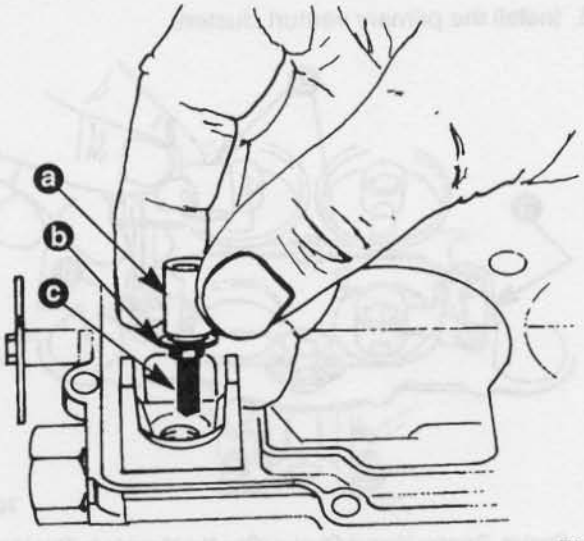
a - Accelerator Pump Lever
b - Accelerator Pump
c - "S"-Shaped Link
d - Retaining Screw

18. Install gasket on top of carburetor.



70448

19. Install inlet filter in bottom of inlet seat. Install inlet seat with gasket in place. Tighten securely.

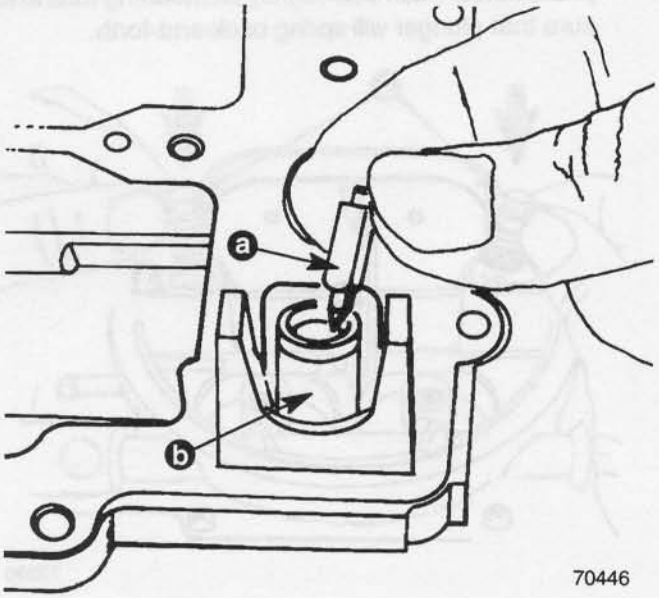


70447

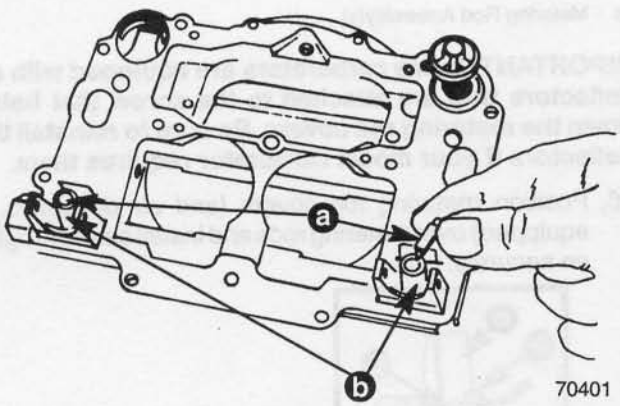
a - Seat
b - Gasket
c - Inlet Filter

IMPORTANT: If using existing needles and seats, be sure to reinstall them as matched sets, as noted during disassembly.

20. Install appropriate inlet needles into inlet seats.



70446

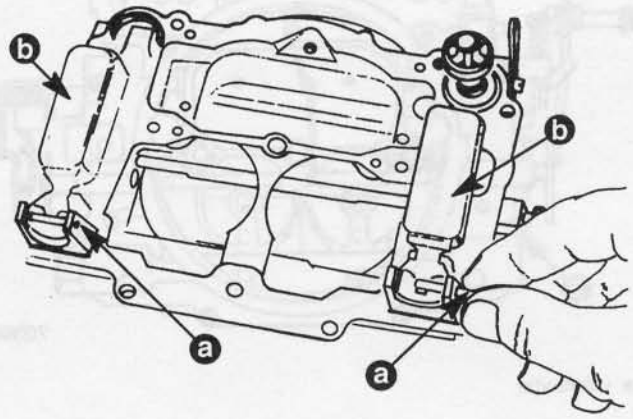


70401

a - Inlet Needle(s)
b - Seat(s)

IMPORTANT: If using existing floats, be sure to reinstall them on the same side as removed.

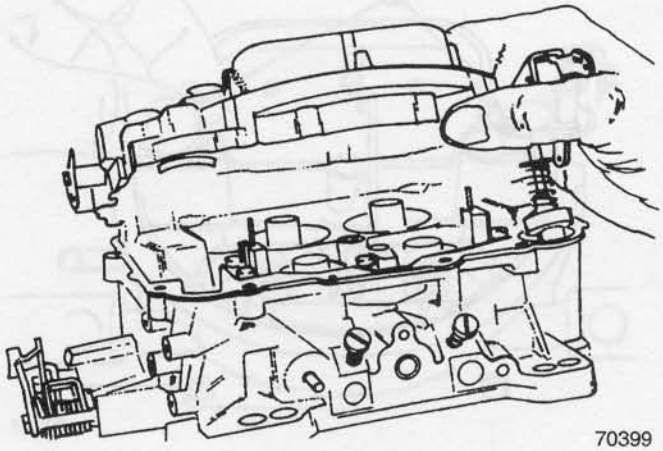
21. Install floats using hinge pins.



70400

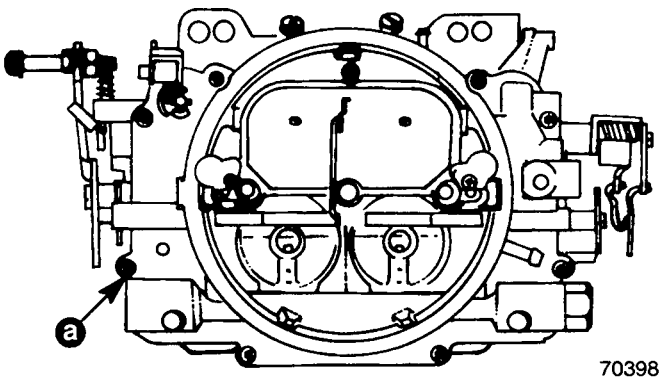
a - Pin(s)
b - Float(s)

22. Carefully lower top of carburetor onto bottom part.



70399

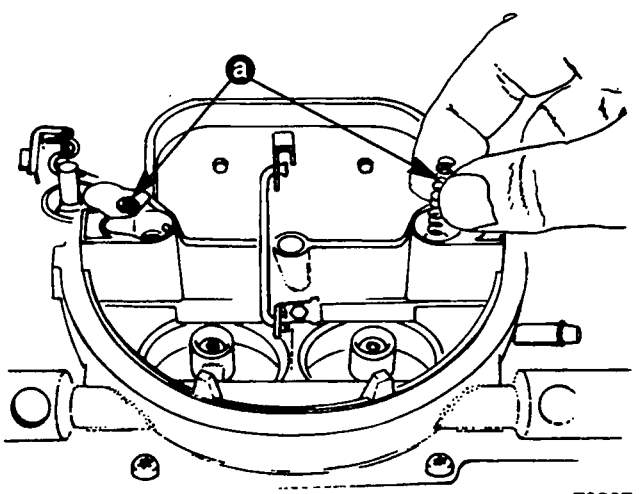
23. Ensure gasket is properly positioned between the two parts and secure the top to bottom with screws (9 total). Tighten securely.



70398

a - Screw(s)

24. Install metering rod springs into each metering rod hole. Be certain to install the appropriate color spring (refer to "Specifications").

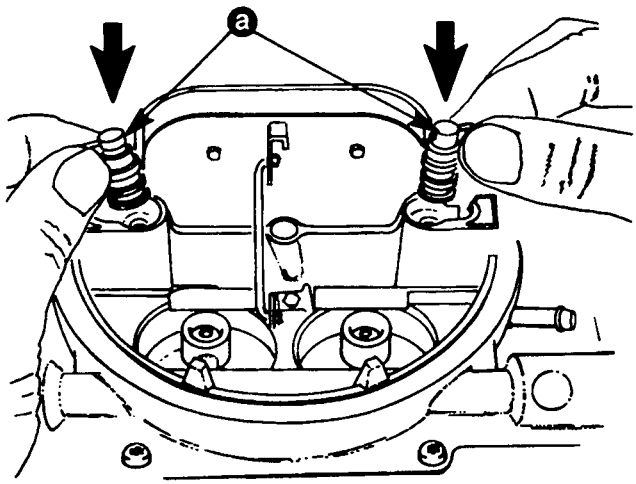


70397

a - Spring(s)

IMPORTANT: If using existing metering rods, be sure that they are reinstalled in the same side from which removed during disassembly.

25. Carefully install metering rod assemblies in the appropriate holes. Push down lightly on metering rods to ensure that plunger will spring back-and-forth.

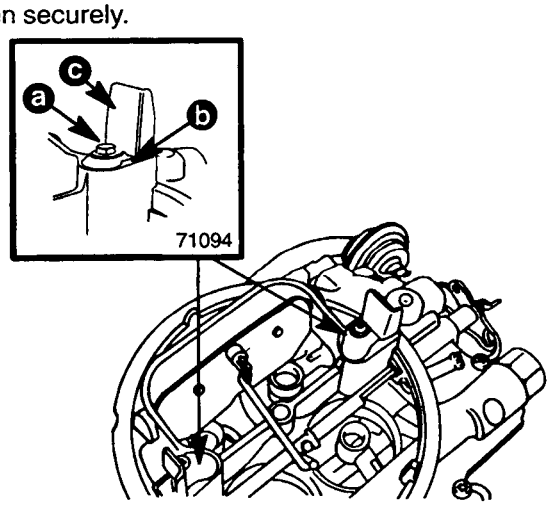


70396

a - Metering Rod Assembly(s)

IMPORTANT: Some carburetors are equipped with air deflectors that are attached to the screw that holds down the metering rod covers. Be sure to reinstall the deflectors if your model carburetor requires them.

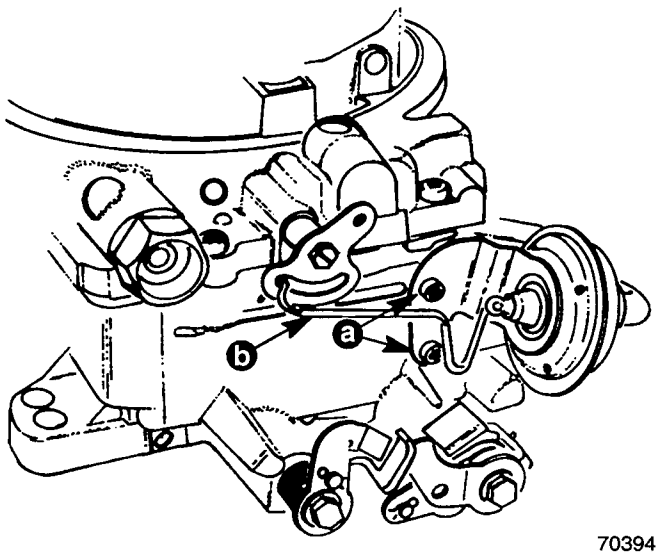
26. Position metering rod covers (and air deflectors, if equipped) over metering rods and install screws. Tighten securely.



71095

a - Screws
b - Metering Rod Cover(s)
c - Air Deflectors (If So Equipped)

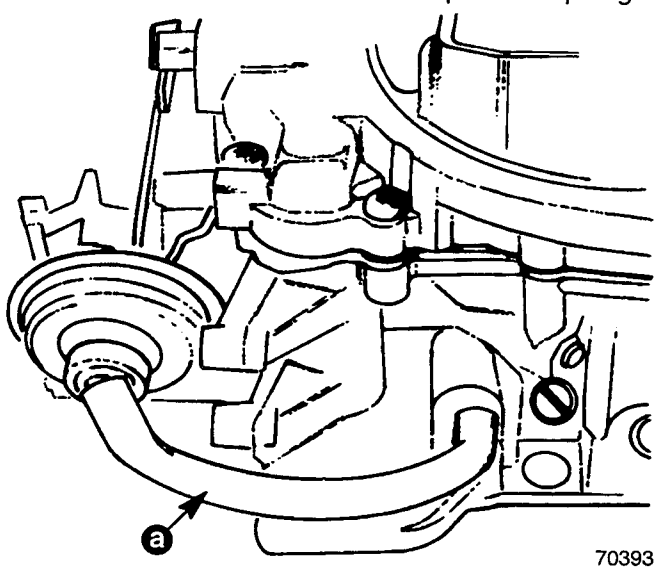
27. Reconnect choke pull-off linkage to carburetor. Reinstall choke pull-off diaphragm. Secure with two screws and tighten securely.



70394

a - Screw(s)
b - Linkage Rod

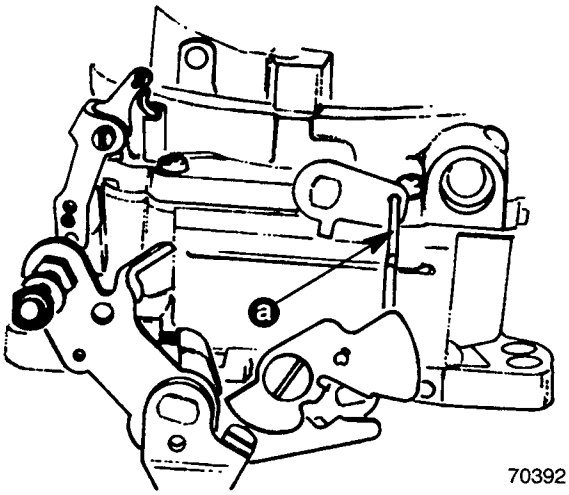
28. Reconnect vacuum hose to choke pull-off diaphragm.



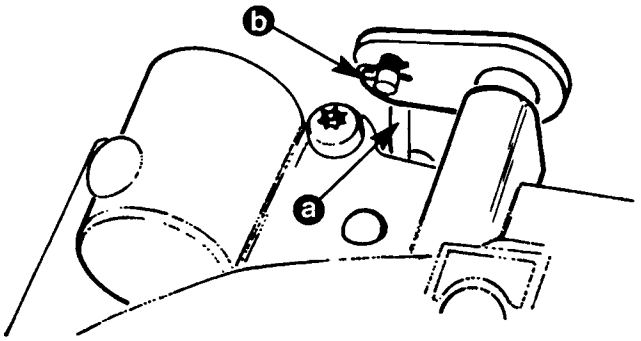
70393

a - Vacuum Hose

29. Reconnect choke plate linkage. Secure with wire clip.



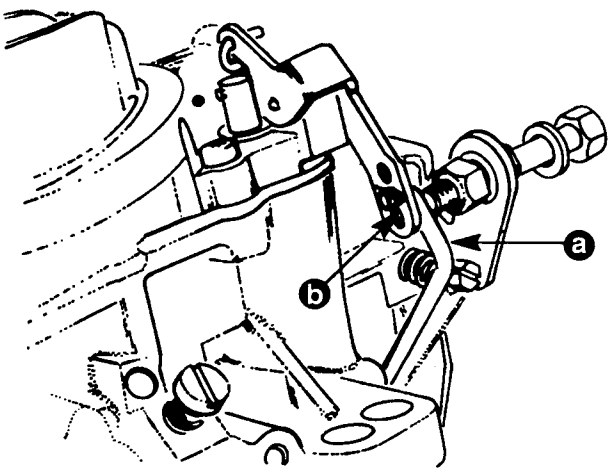
70392



70391

a - Choke Plate Linkage Rod
b - Wire Clip

30. Reconnect accelerator pump linkage rod to **center** hole in accelerator pump lever. Secure using wire clip.

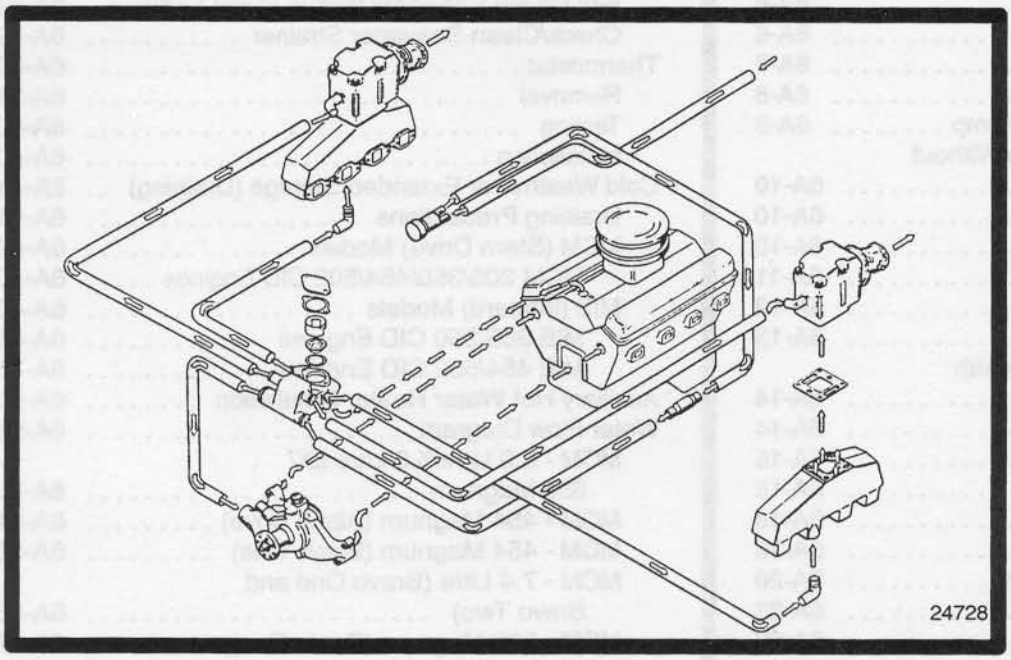


70390

a - Accelerator Pump Linkage Rod
b - Wire Clip

31. Refer to "Installation" and install carburetor.

COOLING SYSTEM



SEAWATER COOLED MODELS

6

A

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Torque Specifications

Fastener Location	Lb. Ft. (N·m)	Lb. In. (N·m)
Alternator Brace to Alternator		192 (28)
Alternator Brace to Block	30 (41)	
Alternator to Mounting Bracket	35 (48)	
Alternator Mounting Bracket	30 (41)	
Drain Plugs (Note 1)	Securely	
Petcocks	Securely	
Power Steering Pump Brace to Block	30 (41)	
Power Steering Pump Bracket	30 (41)	
Pulleys	Securely	
Seawater Pump Brace (Note 2)	30 (41)	
Seawater Pump Bracket to Block (Note 2)	30 (41)	
Seawater Pump Clamping Screw on Cast Bracket (Note 2)	20 (27)	
Seawater Pump Cover (Note 2)		120 (14)
Seawater Pump Mounting Nuts to Stamped Steel Bracket (Note 2)		120 (14)
Fuel Pump to Housing (Note 3)	25-28 (34-38)	
Fill and Drain Screws (Note 3)		18 (2)
Water Pump Thru-Bolts (Note 3)	10-15 (14-20)	
Idler Bracket to Housing (Note 3)	30-35 (41-47)	
Pump Assy. to Engine (Note 3)	30 (41)	
Idler Pulley Locknut (Note 3)	30 (41)	
Hose Clamps	Securely	
Thermostat Cover	30 (41)	
Thermostat Housing	30 (41)	
Thru-Hull Pickup Nut	30 (41)	
Water Circulating Pump	30 (41)	
Water Temp. Sender	20 (27)	

NOTE 1. Coat threads with Perfect Seal before installing.

NOTE 2. Engines with separate seawater pump and fuel pump.

NOTE 3. Engines with combination seawater pump and fuel pump assembly.

Tools/Lubricants/Sealants

TOOLS/LUBRICANTS/SEALANTS	
Part No.	**Description**
91-37241	Universal Puller Plate
91-32609-1	Quicksilver Loctite (A)
91-34227-1	Quicksilver Perfect Seal
91-86154A1	Quicksilver 2-4-C Marine Lubricant
91-79214A1	Quicksilver Special Lubricant 101
73971A2	Flush Device
J-25034	Pulley Puller (Kent-Moore)
92-816026A__	Quicksilver High Performance Gear Lube
92-13872A1	Quicksilver Special Lubricant 101
Obtain Locally	Loctite Pipe Sealant with Teflon
92-75505--1	Loctite 514

Kent-Moore Special Tools

Can Be Ordered From:

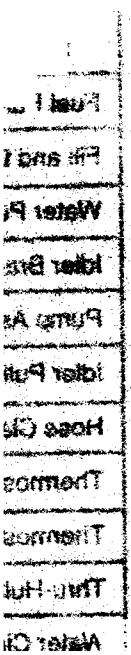
Kent-Moore Tools, Inc.
29784 Little Mack
Roseville, MI 48066
Phone: (313) 574-2332

LUBRICANT OBTAINED LOCALLY
Shell Alvania No. 2

Specifications

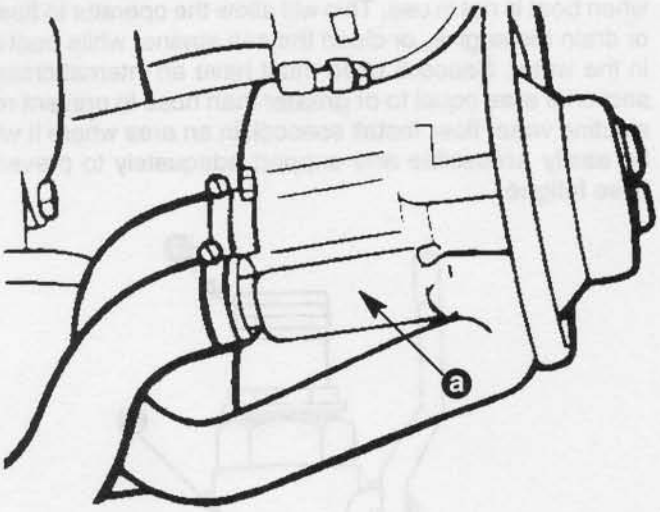
COOLING SYSTEM CAPACITY	
Model [C.I.D. (Litre)]	**Qts. (Litres) Approximately**
MCM/MIE 305/350 (5.0/5.7)	15 (14.1)
MCM/MIE 454/502 (7.4/8.2)	20 (18.9)

THERMOSTAT	
All Models	143° F (62° C)



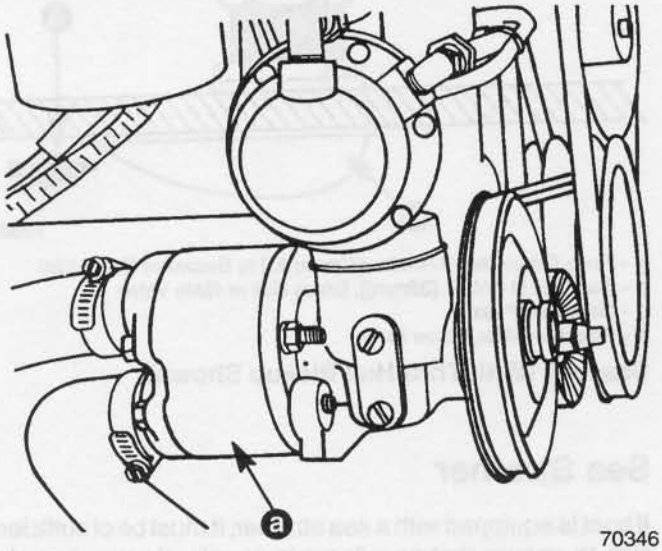
Identification

Seawater Pump



71333

Seawater Pump Without Combination Fuel Pump

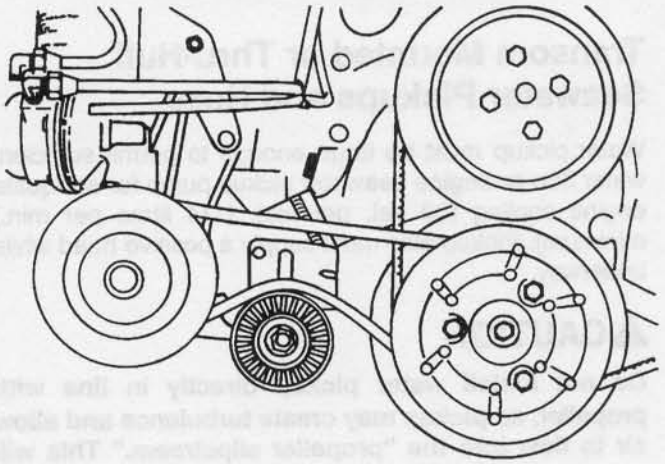


70346

Seawater Pump With Combination Fuel Pump

a - Seawater Pump

Belt Configuration on Seawater Pump with Combination Fuel Pump



71167

Left-Hand Rotation Engines

Seawater Inlet Recommendations

Transom Mounted or Thru-Hull Seawater Pickups and Hose

Water pickup must be large enough to permit sufficient water flow to engine seawater pickup pump for adequate engine cooling [30 gal. per min. (114 litres per min.) minimum]. Pickup also must supply a positive head while underway.

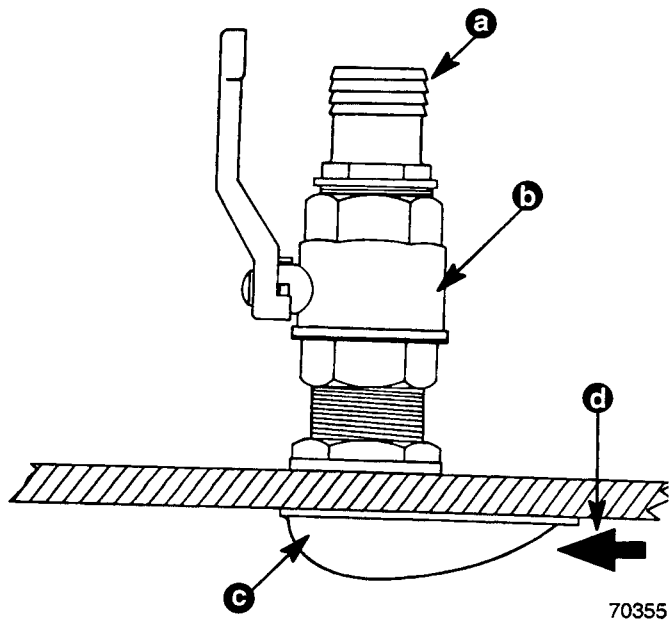
⚠CAUTION

Do not install water pickup directly in line with propeller, as pickup may create turbulence and allow air to flow into the "propeller slipstream." This will cause propeller ventilation and will adversely affect boat performance.

Water pickup should be located as close to seawater pickup pump inlet as possible and in an area where an uninterrupted, solid stream of water will flow past when boat is underway. Connect water pickup to seawater pickup pump inlet with 1-1/4″ (32mm) ID wire reinforced hose of adequate wall thickness to prevent it from collapsing from pump suction. Be sure to secure hose connections with hose clamps.

Seacock (Seawater Inlet Valve)

If a seacock is being used, it must be installed between water pickup and seawater pickup pump (or sea strainer), to allow operator to shut off the seawater in case of a leak or when boat is not in use. This will allow the operator to flush or drain the engine, or clean the sea strainer while boat is in the water. Seacock used must have an internal cross-sectional area equal to or greater than hose to prevent restricting water flow. Install seacock in an area where it will be easily accessible and support adequately to prevent hose fatigue.



a - Hose Connector [1-1/4 in. (32mm) ID] to Seawater Pump Inlet
b - Seacock [1-1/4 in. (32mm)], Brass Ball or Gate Valve
c - Seawater Pickup
d - Direction of Seawater Flow

Seacock (With Thru-Hull Pickup Shown)

Sea Strainer

If boat is equipped with a sea strainer, it must be of sufficient size to ensure that an adequate supply of water is maintained for engine cooling. Install seawater strainer in an area where it will be easily accessible for inspection and cleaning. Strainer should be installed in water inlet hose after water inlet valve to allow operator to shut off water when cleaning strainer.

Seawater Pickups

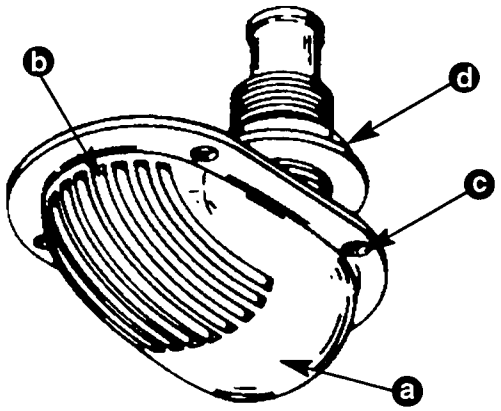
NOTICE

Refer to manufacturer's instructions for information on removal and installation of other than Quicksilver Seawater Pickups.

IMPORTANT: Seal the inside edges of any hole made through the hull with a suitable sealant to prevent water absorption and deterioration.

Thru-Hull Mounted

(Quicksilver Part Number: 68670A2)



a - Seawater Pickup
b - Seawater Inlet Slots (MUST Face Forward - Parallel with Water Flow)
c - Mounting Screw Holes (If So Designed)
d - Nut

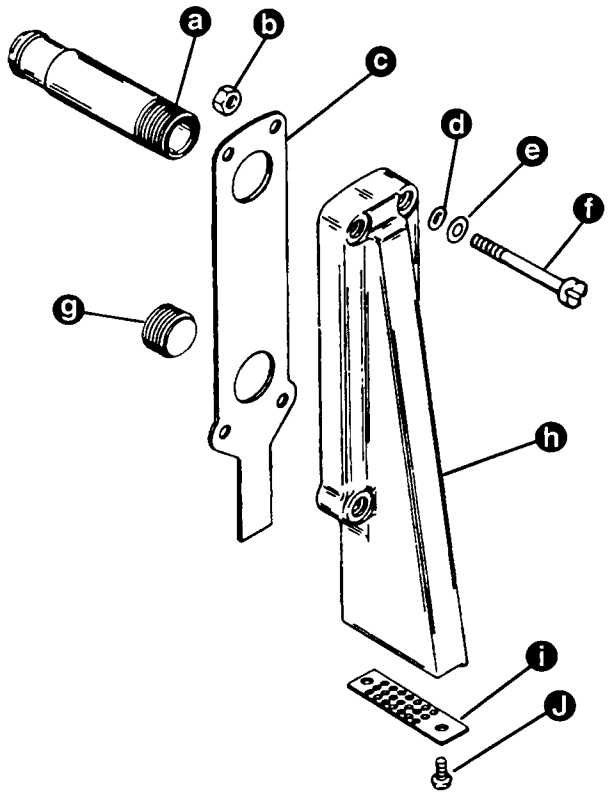
Quicksilver Thru-Hull Seawater Pickup Shown

1. Seal inside edges of 1-3/4" (44mm) hole in hull using a suitable sealer.
2. Apply marine caulking (sealer) to mounting surface on seawater pickup where hull contact will occur when installed.
3. Ensure slots in seawater pickup are facing forward (toward bow of boat) and install seawater pickup through hull. The slots must be parallel with flow of water.
4. Fasten pickup with four (4) appropriate mounting screws (if so designed).
5. Apply marine caulking as needed inside boat. Apply Loctite to threads of nut and install on pickup on inside of boat and torque nut to 35 lb. ft. (42 N·m).

NOTE: If pickup being installed does not have mounting screws on underside where mounted to hull, be certain after nut is torqued that slots are still facing forward.

Transom Mounted

(Quicksilver Part Number: 88845A1)



a - Hose Nipple - Pipe Thread Sealer on Threads, Tighten Securely
b - Nuts (4) - Tighten Securely
c - Gasket - Between Pickup and Transom
d - O-ring (4)
e - Washer (4)
f - Screw (4) - Coat Each Shaft with Silicone Sealant or Equivalent
g - Plastic Plug - Teflon Paste to Threads, Tighten Securely
h - Pickup
i - Screen
j - Screw (2) - Tighten Securely

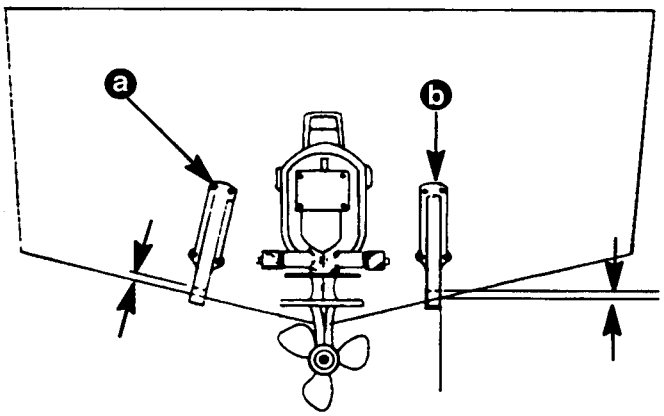
Seawater Pickup Installation

1. Seal the inside edges of the 1-1/2 in. (38mm) hole selected as desired location of hose nipple.
2. Be certain hose nipple and plastic plug are in place and threads have been sealed with Loctite Pipe Sealant with Teflon prior to tightening each securely.

NOTE: Use a sharp knife or wood chisel to remove excess plastic plug material so that plug is flush with pickup casting.

3. Position one flat washer and one rubber O-ring on each 5/16 in. x 4 in. (102mm) long, round head screw as shown. Coat each screw shaft with silicone sealant or equivalent (obtain locally).
4. Place new gasket on pickup housing and hold pickup in place on transom. Install four round head screws (with washers and O-rings in place) into pickup mounting holes and through drilled 21/64 in. (8.4mm) holes in transom.

NOTE: Some installations may have 7/32 in. (5.6mm) holes drilled in transom using four 5/16 in. diameter stainless steel lag bolts in place of round head screws. In any case, flat washers and O-rings are required as outlined.



a - Diagonal Mount [Leading Edge of Pickup 1/8 in. (3.2mm) from Boat Bottom]
b - Vertical Mount [Corner of Leading Edge of Pickup 1/8 in. (3.2mm) from Boat Bottom]

Water Pickup Installed on Transom

5. Secure water pickup from inside with locknuts and washers (unless using lag bolts).
6. Tighten fasteners securely.

Sea Strainer (Quicksilver)

NOTICE

Refer to manufacturer's instructions for information on removal and installation of other than Quicksilver Sea Strainer.

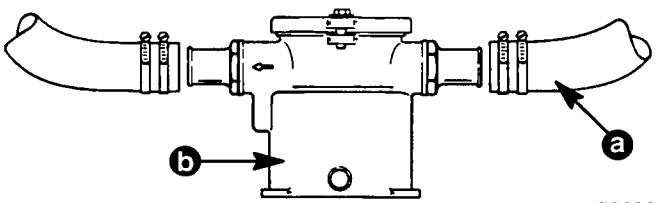
Removal

⚠CAUTION

If boat is in water while working on seawater strainer, close seacock, if so equipped. If boat is not equipped with a seacock, remove and plug seawater inlet hose to prevent a siphoning action that may occur, allowing seawater to flow from the drain holes or removed hoses and enter boat.

IMPORTANT: Be certain engine is off and cooling system is cold.

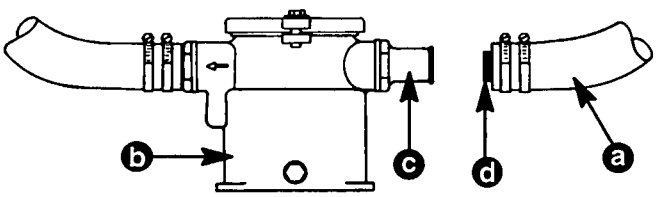
1. Follow "a" or "b" instructions:
   a. **Models Equipped with Seacock:**
      (1) Close seacock (seawater inlet valve), if so equipped.
      (2) Disconnect seawater inlet hose from seawater strainer.



50226

a - Seawater Inlet Hose
b - Seawater Strainer

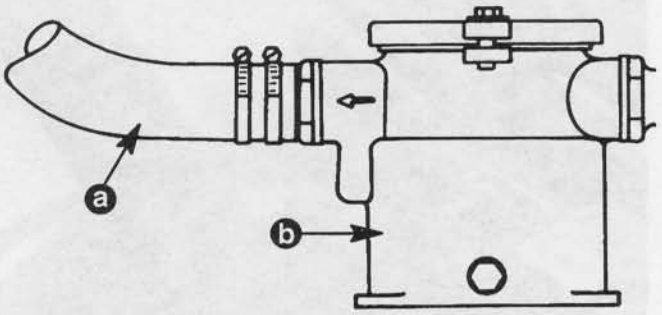
   b. **Models without Seacock:**
      (1) If not equipped with seacock, disconnect seawater inlet hose, from seawater strainer inlet, and plug seawater inlet hose.



70062

a - Seawater Inlet Hose
b - Seawater Strainer
c - Seawater Strainer Inlet
d - Plug

2. Remove outlet hose. Drain into a suitable container.



70062

a - Seawater Outlet Hose
b - Seawater Strainer

3. Remove mounting bolts. Remove strainer.

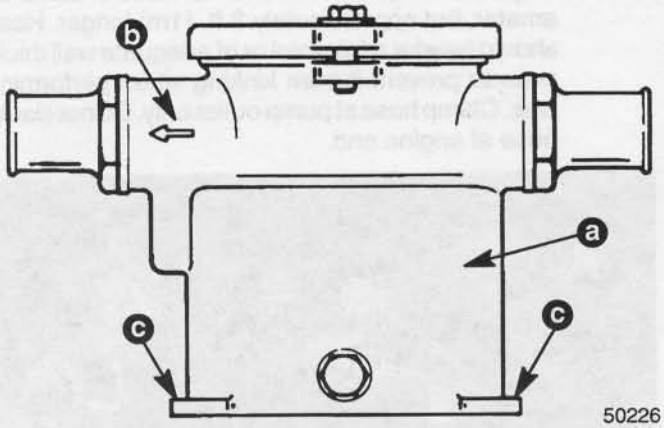
Installation

IMPORTANT: Mount seawater strainer in a vibration-free location. Never mount it on the engine or transmission. Hoses must not be kinked or allowed to come in contact with hot or moving engine or transmission parts.

1. Mount seawater strainer.

   Arrow must point towards seawater pump.

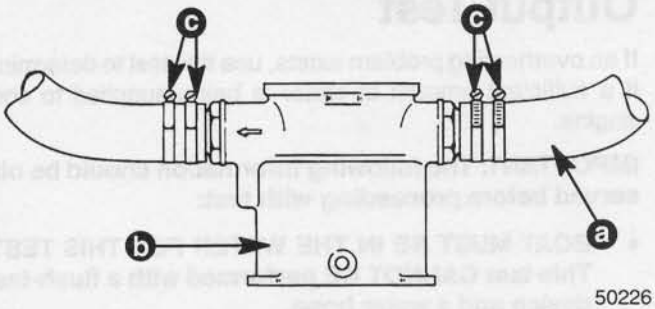
   Tighten mounting bolts securely.



50226

a - Seawater Strainer
b - Arrow
c - Mounting Bolt Hole Location (Bolts Not Shown)

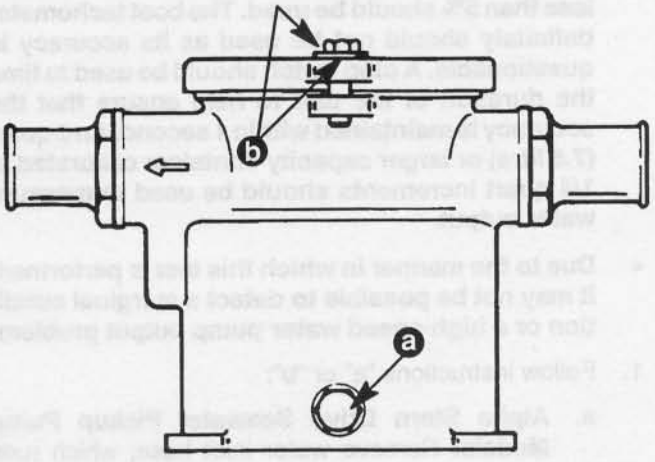
2. Install inlet and outlet hoses. Use 2 hose clamps on each hose connection. Tighten clamps securely.



50226

a - Seawater Inlet Hose
b - Seawater Strainer
c - Double Hose Clamps

3. Check drain plug and lens cover bolts. Tighten securely. Do not overtighten cover bolts or cover may warp and leak water into boat.



50226

a - Drain Plug
b - Lens Cover Bolts – (2, One Hidden In This View)

Seawater Pickup Pump Output Test

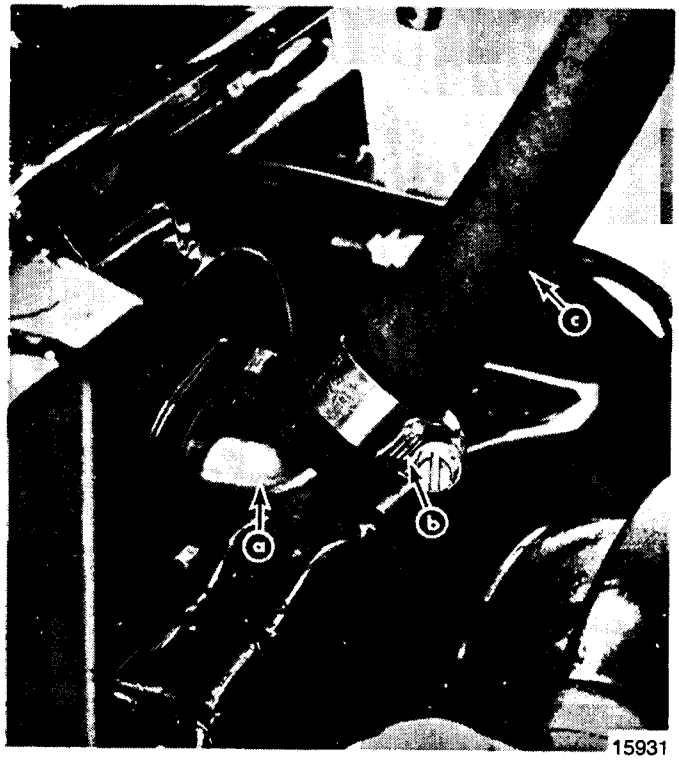
If an overheating problem exists, use this test to determine if a sufficient amount of water is being supplied to cool engine.

IMPORTANT: The following information should be observed before proceeding with test:

- **BOAT MUST BE IN THE WATER FOR THIS TEST. This test CANNOT BE performed with a flush-test device and a water hose.**
- **The ability of this test to detect a problem is greatly dependent upon the accuracy in which it is performed. An error in setting the engine RPM, timing the test or measuring the water output will affect the overall accuracy of the test and may produce misleading results. To help ensure accurate results, a shop tachometer with an error of less than 5% should be used. The boat tachometer definitely should not be used as its accuracy is questionable. A stop watch should be used to time the duration of the test to help ensure that the accuracy is maintained within 1 second. An 8 quart (7.6 litre) or larger capacity container calibrated in 1/4 quart increments should be used to measure water output.**
- **Due to the manner in which this test is performed, it may not be possible to detect a marginal condition or a high-speed water pump output problem:**

1. Follow instructions "a" or "b":

   a. **Alpha Stern Drive Seawater Pickup Pump Models:** Remove water inlet hose, which runs between gimbal housing water tube and engine, and replace with another hose of same diameter, but approximately 3 ft. (1m) longer. Hose should be wire reinforced or of adequate wall thickness to prevent it from kinking when performing test. Clamp hose at gimbal housing water tube only. Do not clamp hose at engine end.

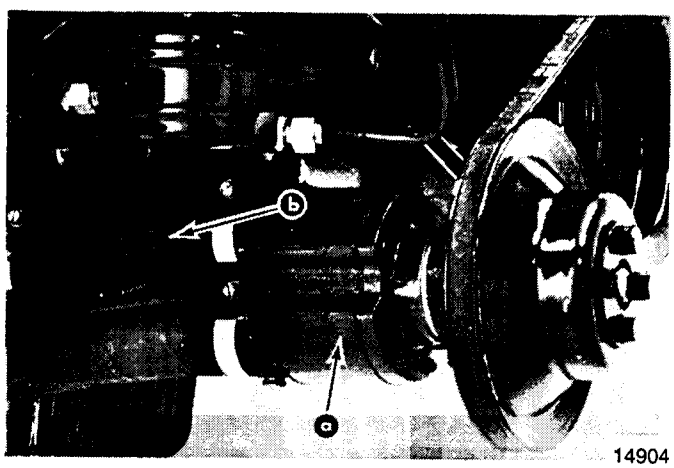


15931

a - Water Tube
b - Hose Clamp
c - Water Hose

Alpha Stern Drive Pump Models

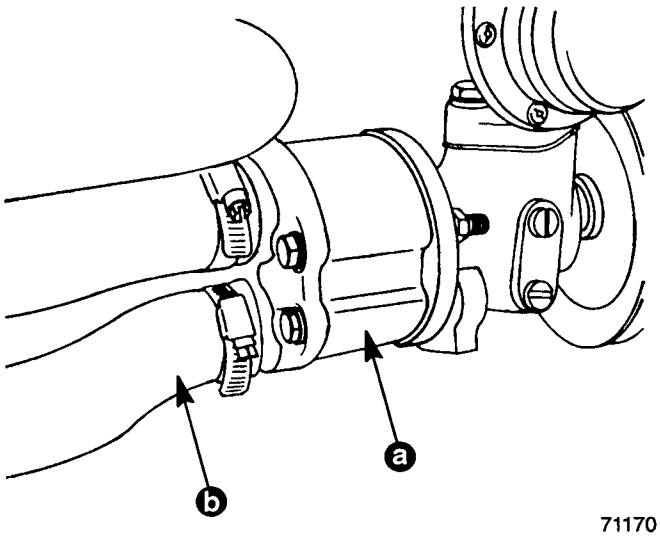
   b. **Belt Driven Seawater Pickup Pumps:** Remove water hose, which runs between pump outlet and engine and replace with another hose of same diameter, but approximately 3 ft. (1m) longer. Hose should be wire reinforced or of adequate wall thickness to prevent it from kinking when performing test. Clamp hose at pump outlet only. Do not clamp hose at engine end.



14904

a - Seawater Pickup Pump
b - Seawater Outlet Hose

Belt Driven Pump Without Combination Fuel Pump



71170

a - Seawater Pickup Pump
b - Seawater Outlet Hose

Belt Driven Pump With Combination Fuel Pump

2. Place an 8 quart (8 litres) or larger container near unclamped end of hose.

⚠CAUTION

Do not run engine for more than 15 seconds with hose disconnected, in next step, as internal damage to engine and exhaust system may result.

3. With assistance of another person, start engine and adjust speed to exactly 1000 RPM, while holding unclamped end of hose on connection on engine. Remove hose from connection on engine and direct water flow into container for exactly 15 seconds. At the end of 15 seconds, direct the water flow overboard, return engine to idle and stop engine. Reconnect hose to engine.
4. Measure quantity of water discharged into container and compare with specifications given in chart following.
5. Repeat test 4 times to check repeatability of results.

ALPHA and ALPHA GENERATION II – STERN DRIVE PUMP OUTPUT FOR 15 SECOND PERIOD	
Drive Unit Gear Ratio	**Minimum Quantity U.S. Qts. (Litres)**
1.98:1	3.0 (2.8 litres)
1.84:1	3.3 (3.1 litres)
1.65:1	3.6 (3.4 litres)
1.50:1	4.0 (3.8 litres)
1.32:1	4.5 (4.3 litres)

BELT DRIVEN PUMP OUTPUT FOR 15 SECOND PERIOD
7.5 U.S. Qts. (7.1 litres) Minimum

Stern Drive Unit Seawater Pickup Pump

NOTICE

MCM (Stern Drive) Models equipped with Alpha Drive Units have a seawater pickup pump mounted in stern drive unit. Refer to appropriate "Stern Drive Service Manual" for testing and repairs.

Belt Driven Seawater Pickup Pump Without Combination Fuel Pump

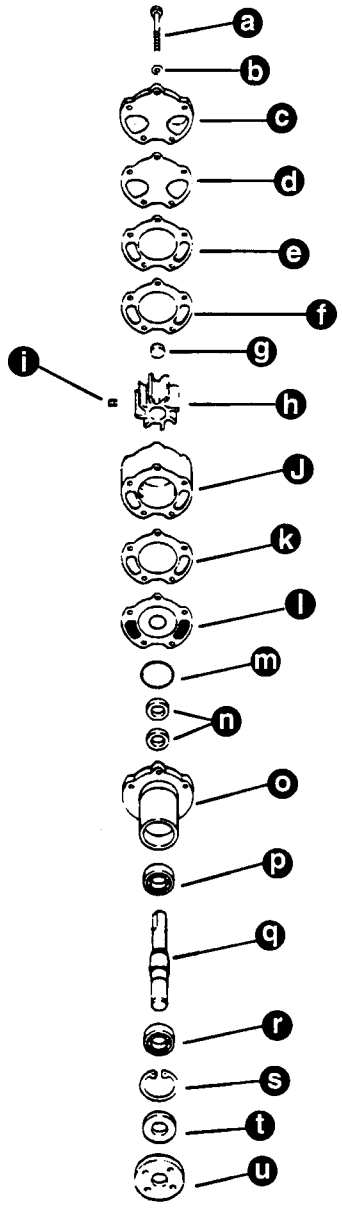
Removal

⚠CAUTION

If boat is in the water, be sure to close seacock before removing inlet hose from pump to prevent water from draining into boat. If boat is not fitted with a seacock, disconnect and plug seawater inlet hose after removing.

IMPORTANT: The following procedure describes removal of both pump and mounting bracket from engine. On some installations, however, it may be possible to remove pump with mounting bracket left installed on engine.

1. Disconnect water inlet and outlet hoses from pump.
2. If pump is to be disassembled, break loose 4 pump pulley attaching screws. Do not remove screws at this time.
3. **On Engines With Power Steering:** Remove Power Steering pump drive belt to allow removal of seawater pickup pump drive belt. (Some models)
4. Remove pulley attaching screws and clamping ring (some models) then remove pulley.
5. Remove attaching hardware which secures pump brace to cylinder block, oil pan or Power Steering pump (as applicable).
6. Remove pump mounting bracket-to-cylinder block attaching hardware and remove pump, mounting bracket and brace as an assembly.
7. Loosen clamping screw, then remove pump. It may be necessary to spread clamping bosses.



a - Screw (5)
b - Washer (5)
c - Cover
d - Gasket
e - Wear Plate (Outer)
f - Gasket
g - Plug
h - Impeller
i - Key (If So Equipped)
j - Body
k - Gasket
l - Wear Plate (Inner)
m - O-ring or Quad Ring
n - Oil Seal
o - Housing
p - Ball Bearing
q - Shaft
r - Ball Bearing
s - Snap Ring
t - Oil Seal
u - Hub

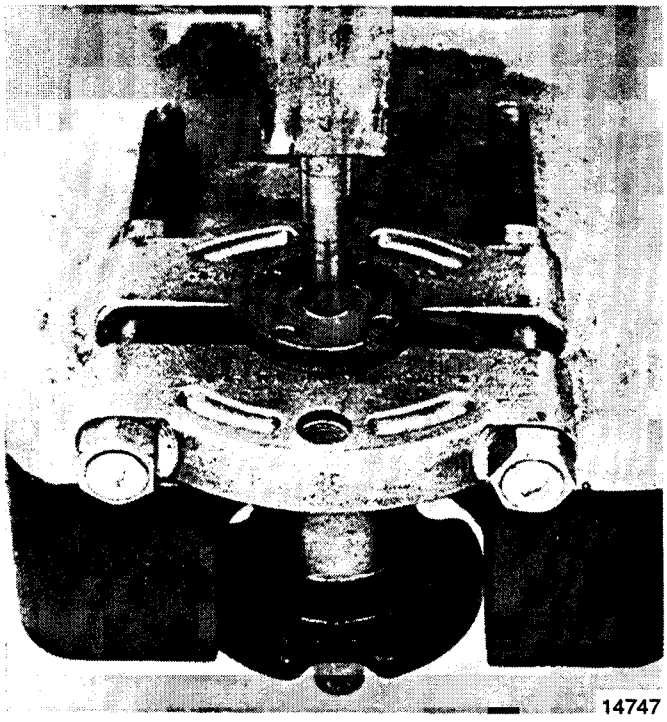
Pump Assembly

Disassembly

NOTE: Some later style pumps do not have an impeller drive key. These pumps have filament-wound impellers with a "D-shaped" hub bore to "key" them to shaft.

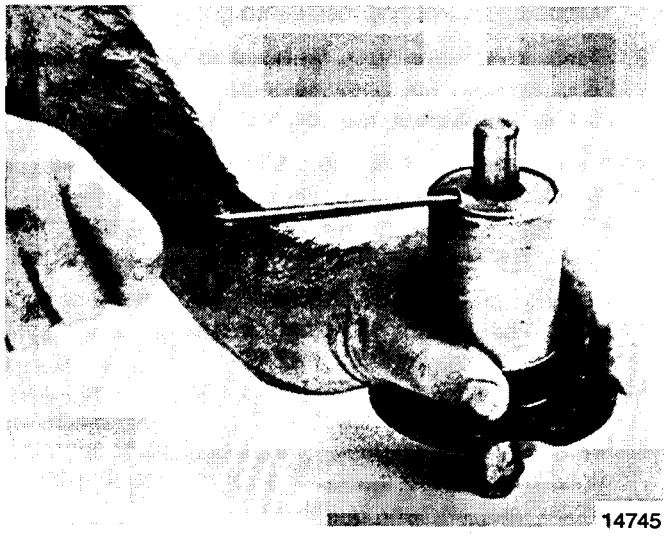
1. Remove cover and body attaching screws and washers. Remove cover, gasket, outer wear plate and gasket. (Discard gaskets.)
2. Slide pump body off shaft. Remove impeller from pump body and rubber plug from impeller.

3. Remove impeller drive key, if so equipped, from pump shaft, then remove gasket, inner wear plate and O-ring (or Quad Ring). Discard gasket and O-ring (or Quad Ring).
4. Press hub off shaft with Universal Puller Plate (91-37241) and an arbor press.


14747

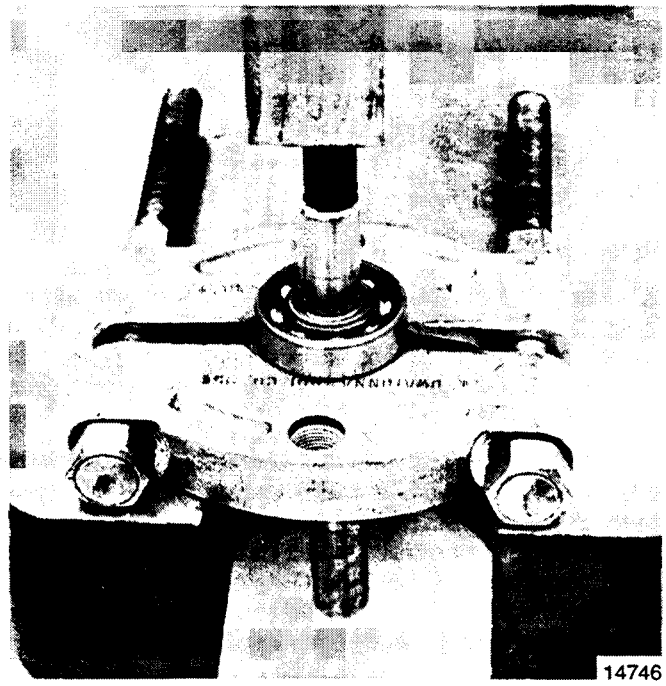
Removing Hub

5. Puncture front oil seal with a tool and pry from bearing housing.


14745

Removing Front Oil Seal

6. Remove snap ring from bearing housing bore and press shaft and bearings out pulley end of housing. Bearings have a slip fit in housing, do not use excessive force.
7. If bearings require replacement, remove bearings from shaft with Universal Puller Plate and an arbor press. Bearings must be replaced, if removed.


14746

Removing Bearings from Pump Shaft

8. If rear seals require replacement, press seals from bearing housing with an appropriate tool.

Cleaning and Inspection

1. Clean metal parts in solvent and blow dry with compressed air.

IMPORTANT: Do not spin bearings at high speed when drying with compressed air, as bearings may be scored.

2. After cleaning, apply a coat of light engine oil to shaft and bearings to prevent rust.
3. Clean all gasket material and sealer from sealing surfaces.
4. Inspect bearing housing. Examine surfaces (where bearings contact housing) for evidence of bearing outer races turning in housing.
5. Inspect seals in bearing housing.
6. Inspect pump shaft bearings.
7. Inspect pump shaft for grooves in surface where seals contact shaft. Inspect keyway in shaft. Also, inspect surface, where bearings contact shaft, for evidence of inner races turning on shaft.
8. Inspect impeller drive key, if so equipped.
9. Inspect pump body.
10. Inspect inner and outer wear plate.

11. Inspect pump impeller for wear on sides and tips of blades. Also inspect blades for cracks in area where blades flex. Replace impeller, if blades have taken a set (remain in curved position).
12. Inspect pump pulley.
13. Check drive belt for excessive wear.

Reassembly

Refer to Figure 1 also.

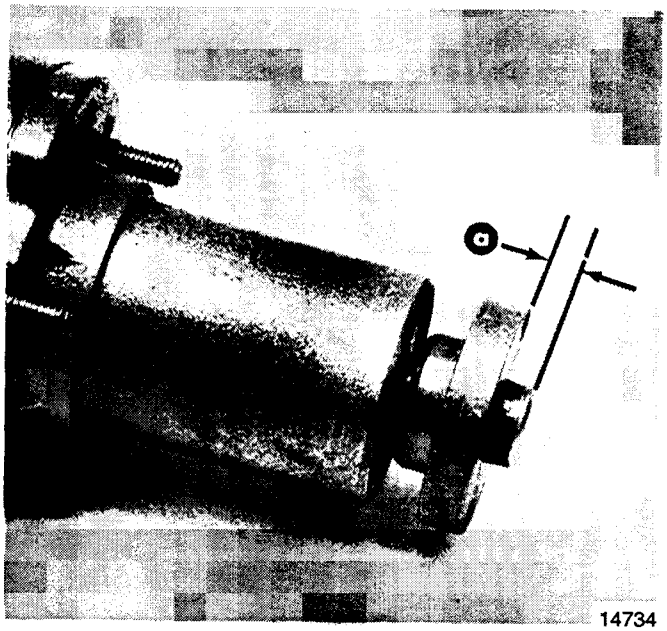
1. Apply a thin coat of Loctite Type "A" to outside diameter of 2 new bearing housing rear seals, then install seals in housing with seal lips facing impeller end. (Press first seal in until it bottoms-out and second seal in until flush with housing.)

IMPORTANT: It is recommended that Shell Alvania No. 2 Grease be used when packing seal and bearings in the following steps. If Shell Alvania No. 2 Grease is not available, it is permissable to use Quicksilver 2-4-C Marine Lubricant. However, Quicksilver 2-4-C Marine Lubricant is not recommended for applications where continuous high speed heavy-duty operation will be encountered.

2. Pack cavity between seals with Shell Alvania No. 2 Grease or substitute.
3. Using an arbor press and suitable tool, press ball bearings onto shaft until they seat. Press on inner race of bearing only.
4. Pack bearings and cavity between bearings with Shell Alvania No. 2 Grease or substitute. Slide bearings and shaft into bearing housing bore and install snap ring.
5. Apply a thin coat of Loctite "A" to outside diameter of new bearing housing front oil seal and press seal into housing (with seal lip facing inward) until it bottoms out.

IMPORTANT: Be sure to support impeller end of pump shaft, when installing pulley hub, in next step, to prevent placing a load on bearings.

6. Apply Special Lubricant 101 to pump shaft. Using an arbor press and appropriate tool, press pulley hub onto pump shaft to dimension shown.



a - 1/4 in. (7mm)

Pulley Hub Dimension

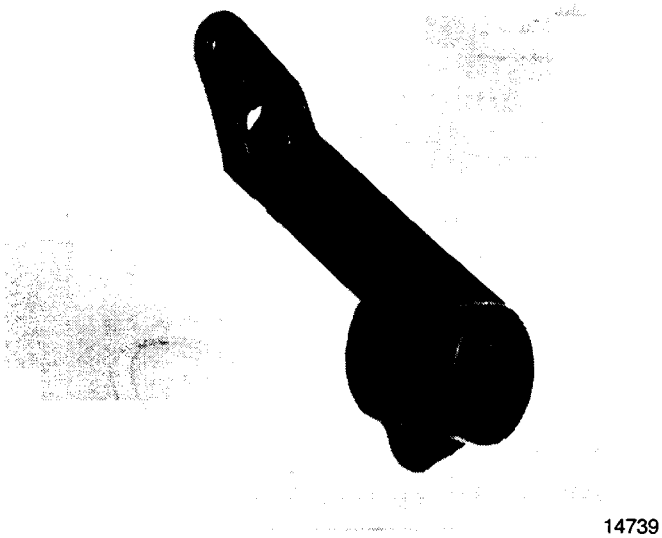
IMPORTANT: Pulley hub must be pressed onto shaft to exact dimension on pumps with stamped steel mounting bracket as this establishes proper drive belt alignment.

7. Clamp bearing housing in a soft jawed vise with flange end up.
8. Coat O-ring (or Quad ring) with Quicksilver 2-4-C Marine Lubricant and install into groove in housing.
9. Place inner wear plate on housing and align holes. Coat both sides of a new wear plate gasket with a thin film of Perfect Seal and position on wear plate.
10. Install impeller into pump body by turning impeller in direction that it will be turning in operation, while simultaneously pushing inward. All impeller blades must face in same direction.
11. If so equipped, apply a small amount of grease to back side of impeller drive key (to hold it in place) and position key in keyway on shaft. Align groove in impeller hub (with drive key, if so equipped), or align "D-shaped" hub bore and slide impeller and pump body assembly onto shaft. Position pump body so that holes align with holes in wear plate, gasket and bearing housing. Install rubber plug into end of impeller.
12. Coat both sides of new cover gasket and wear plate gasket with a thin film of Perfect Seal. Install outer wear plate with new gaskets on each side, aligning holes in plate and gaskets with holes in pump body.
13. Install pump cover and secure with 5 screws and washers. Torque screws to specifications.

Installation

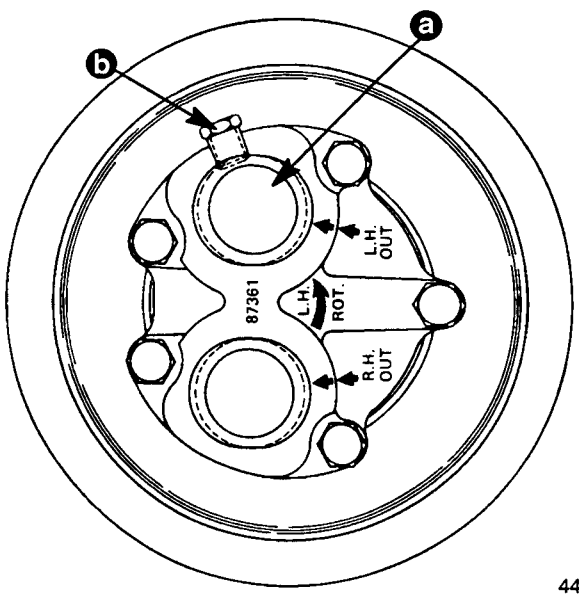
1. Position pump in mounting bracket so that outlet connection will be directly above inlet connection when pump is installed.

IMPORTANT: Pump must be positioned correctly or overheating of engine may occur.



14739

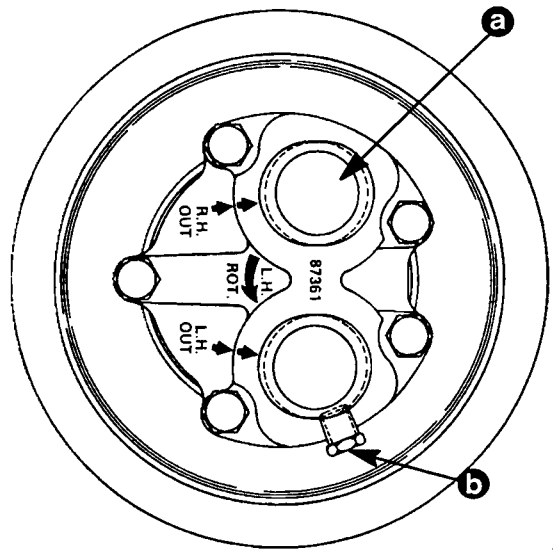
Cast Bracket



448-H

a - L.H. Out - At Top
b - Brass Plug - At Top

MCM and MIE L.H. (Standard) Rotation Engines



448-H

a - R.H. Out - At Top (Some Pumps are Not Marked. In Those Cases, "Out" is At Bottom)
b - Brass Plug - At Bottom

MIE R.H. (Opposite) Rotation Engines

2. Install flat washer (spacer) between mounting bracket clamping bosses and install clamping screw and lockwasher. Do not tighten screw at this time.

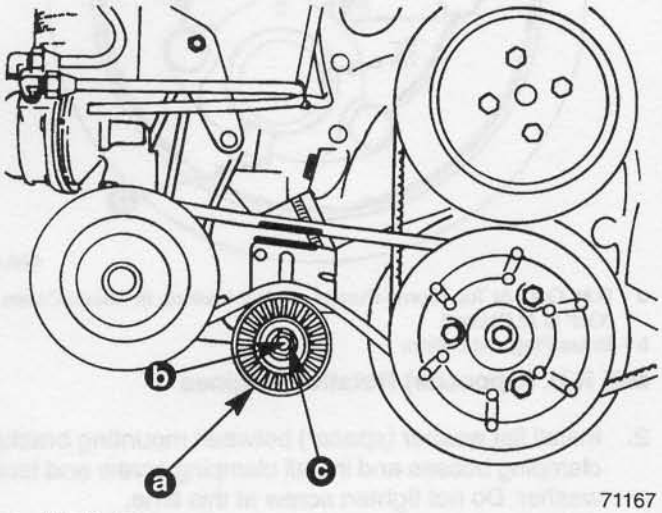
IMPORTANT: Flat washer must be installed between mount bracket clamping bosses or damage to pump may result (if clamping screw is overtightened).

3. Attach brace to pump mounting bracket with screw, lockwasher and nut. Do not tighten at this time.
4. Install pulley on pump and secure with 4 screws, lockwashers and clamping ring (some models). Tighten screws finger tight only at this time.
5. Attach pump, mounting bracket and brace assembly to engine. Do not tighten attaching screws at this time.
6. Slide pump fore or aft in mounting bracket, as required, to properly align pump pulley with crankshaft pulley. After pump has been properly positioned, torque clamping screw to specifications.
7. Torque pump pulley attaching screws.
8. Position drive belt on pulleys and adjust belt tension as outlined in "Drive Belt Tension Adjustment" (see Table of Contents).
9. Connect seawater inlet hose to lower fitting on pump.
10. Connect outlet hose to upper fitting on pump.
11. Tighten hose clamps securely.
12. **Power Steering Models:** If applicable, reinstall drive belt. Adjust tension as outlined in "Drive Belt Tension Adjustment" (see Table of Contents).

Belt Driven Seawater Pickup Pump with Combination Fuel Pump

Removal

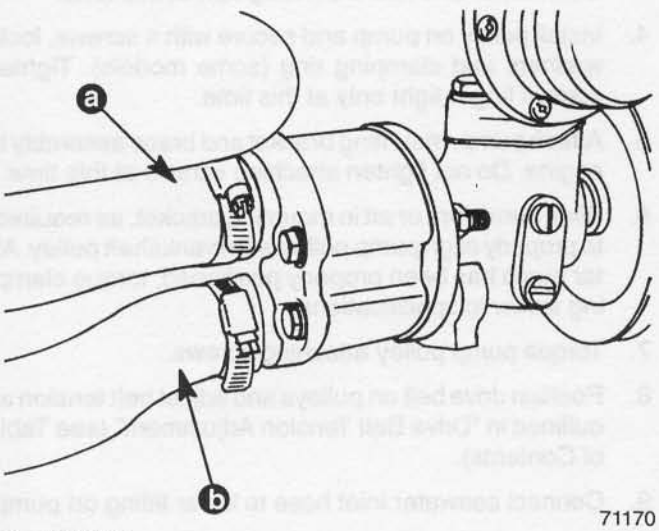
1. Remove drive belt by loosening idler pulley.



71167

a - Idler Pulley
b - Adjusting Bolt
c - Locknut

2. Disconnect water hoses from seawater pump.



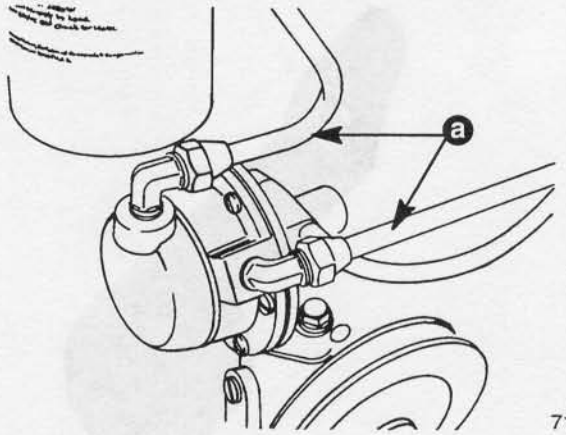
71170

a - Inlet Hose
b - Hose to Cooler

⚠ WARNING

Be careful when working on fuel system components. Gasoline is extremely flammable under certain conditions. Be sure ignition key is OFF. Do not smoke or allow spark or open flame in area when working on fuel system components. Wipe up any spilled fuel immediately.

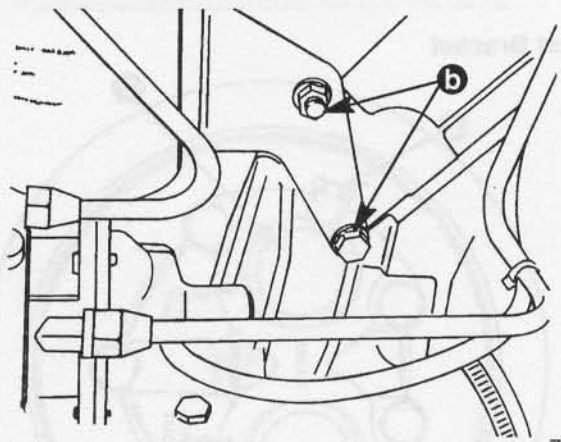
3. Disconnect fuel lines from fuel pump.



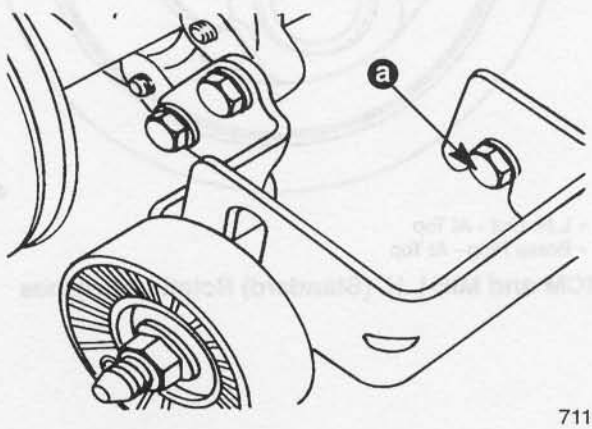
71169

a - Fuel Lines

4. Remove seawater/fuel pump assembly.



71161



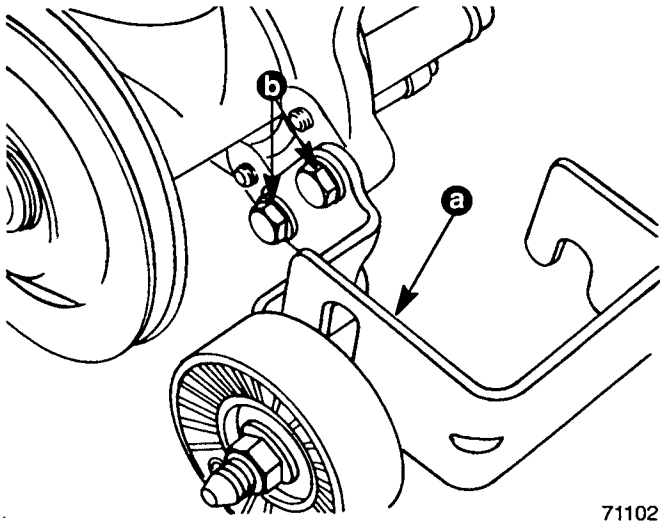
71102

a - Idler Bracket Bolt
b - Main Bracket Bolts (2)

Disassembly

IDLER PULLEY ASSEMBLY

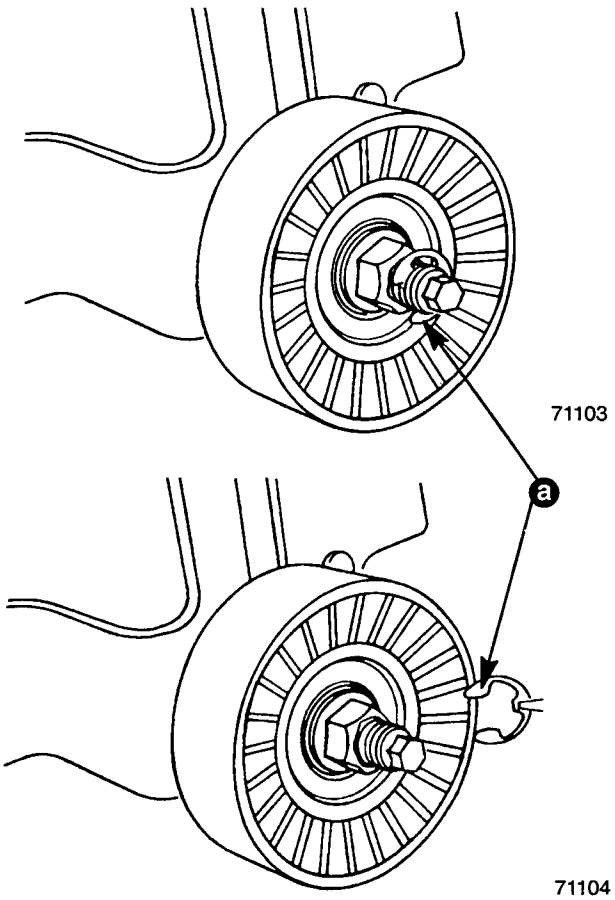
1. Remove idler pulley bracket from pump housing.



71102

a - Bracket
b - Bolts (2)

2. Remove retaining clip from adjusting bolt.

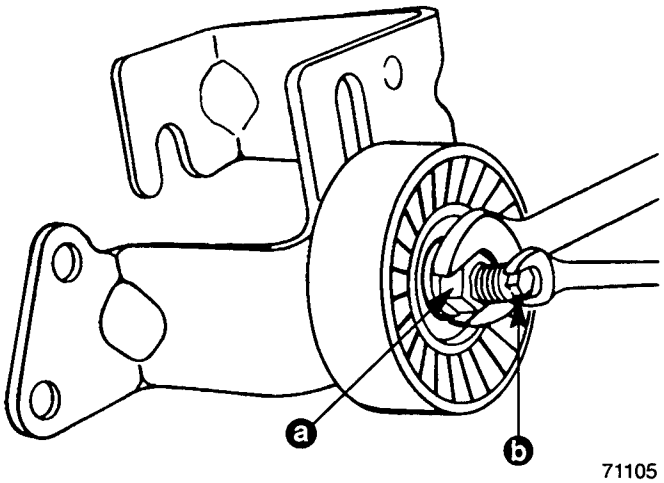


71103

71104

a - Retaining Clip

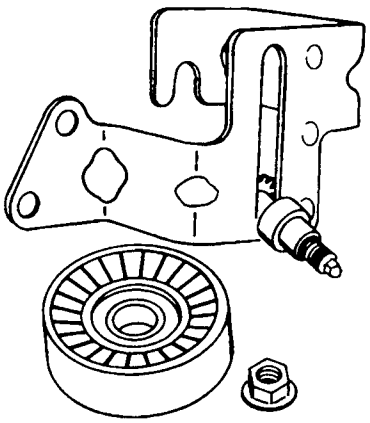
3. Loosen locknut while holding adjustment bolt.



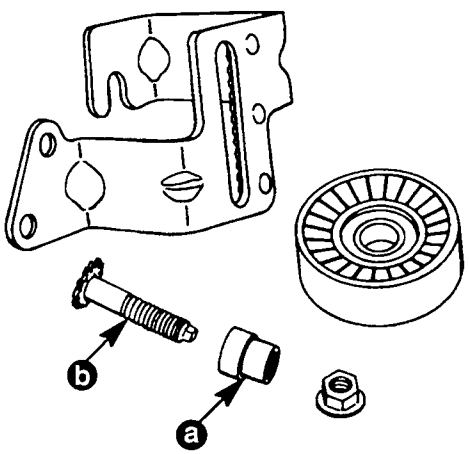
71105

a - Locknut
b - Adjusting Bolt

4. Remove idler pulley, bushing and adjusting bolt.



71106



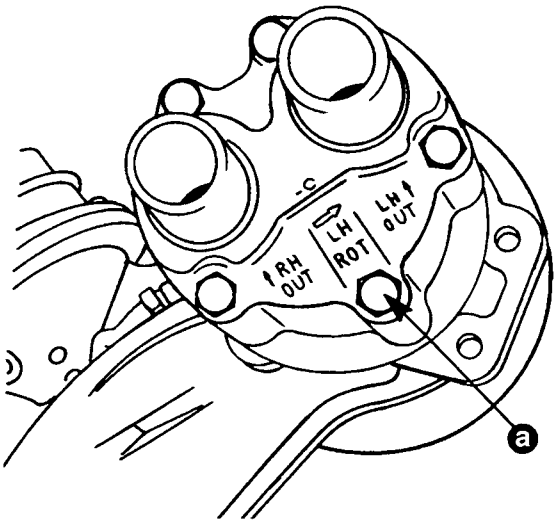
71107

a - Bushing
b - Adjusting Bolt

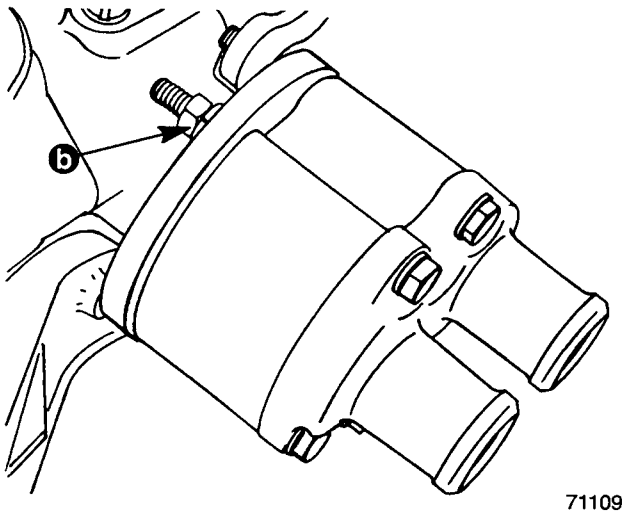
SEAWATER PUMP ASSEMBLY

1. Loosen bolts that secure water pump to housing.

NOTE: One of these bolts is secured with a nut and lockwasher.



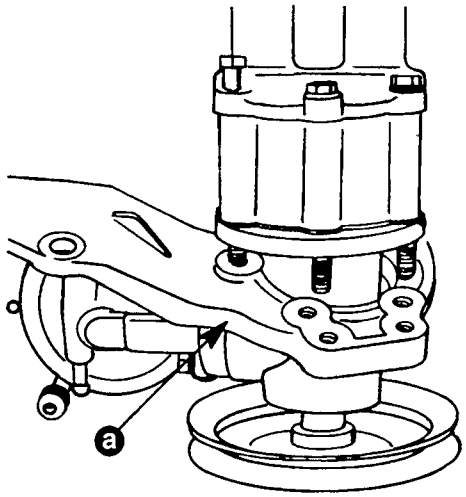
71108



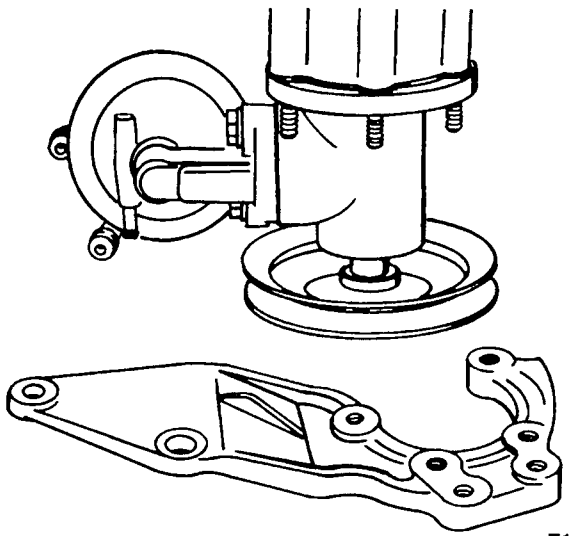
71109

a - Bolts (5)
b - Nut and Lockwasher

2. Remove bracket from pump housing.



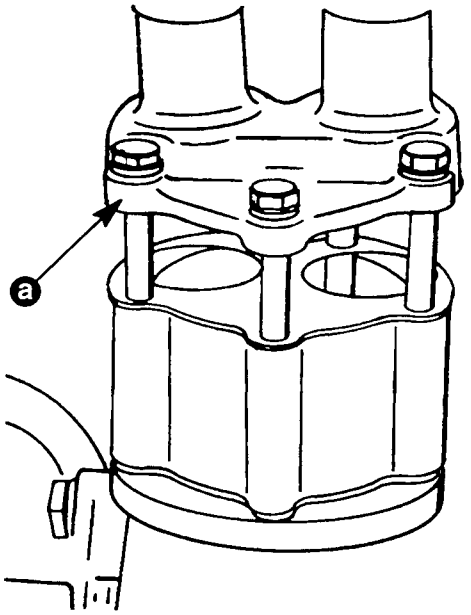
71110



71111

a - Bracket

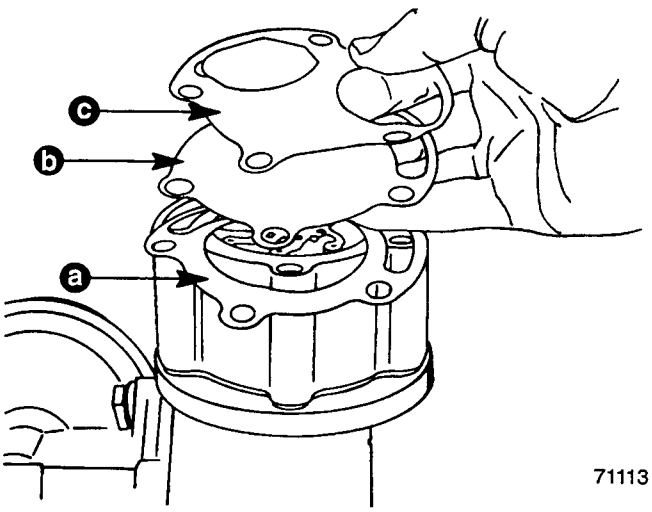
3. Remove water pump end cover from housing.



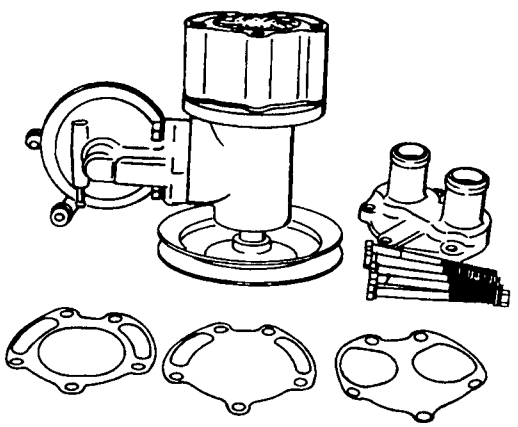
71112

a - End Cover

4. Remove gaskets and separator plate.



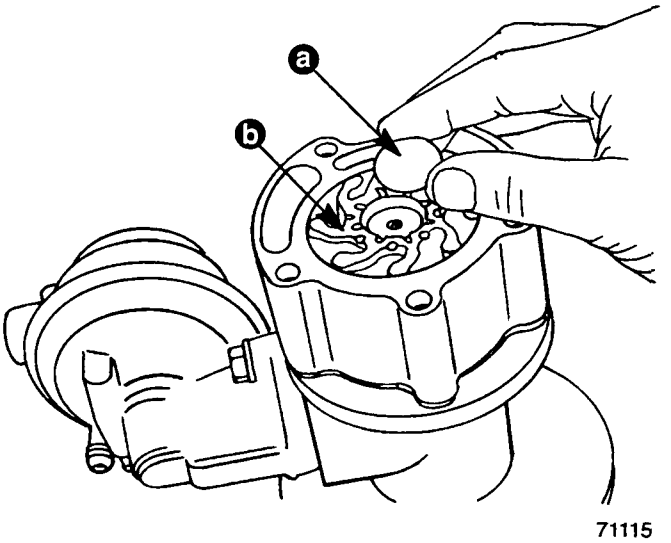
71113



71114

a - Gasket (with Large Opening)
b - Separator Plate
c - Gasket (with Two Openings)

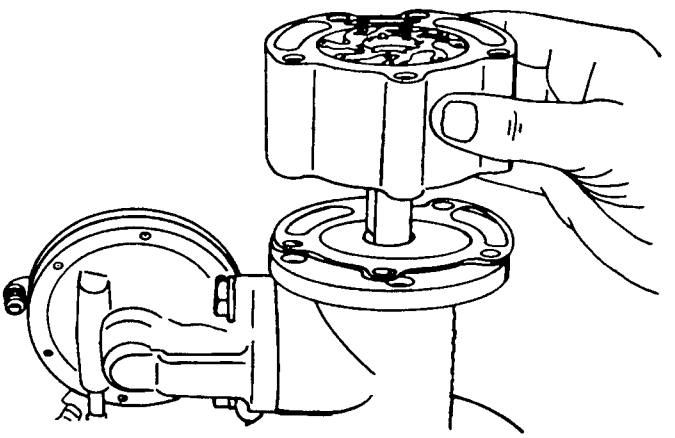
5. Remove rubber plug from end of impeller.



71115

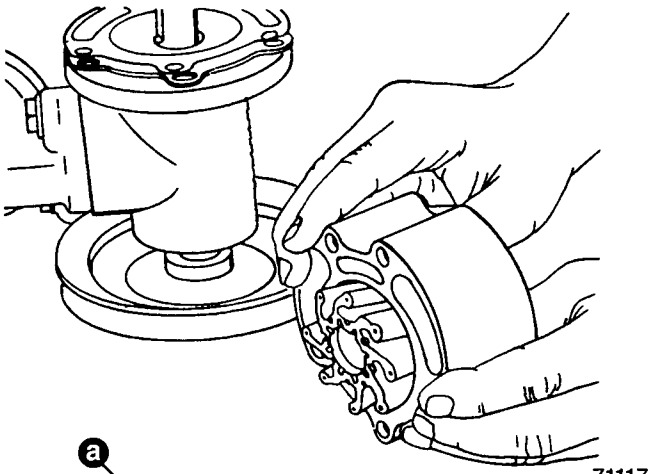
a - Rubber Plug
b - Impeller

6. Lift pump housing off of pump base.

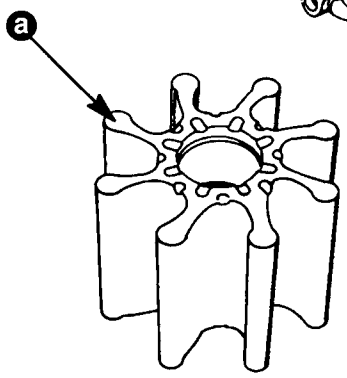


71116

7. Remove impeller from housing.



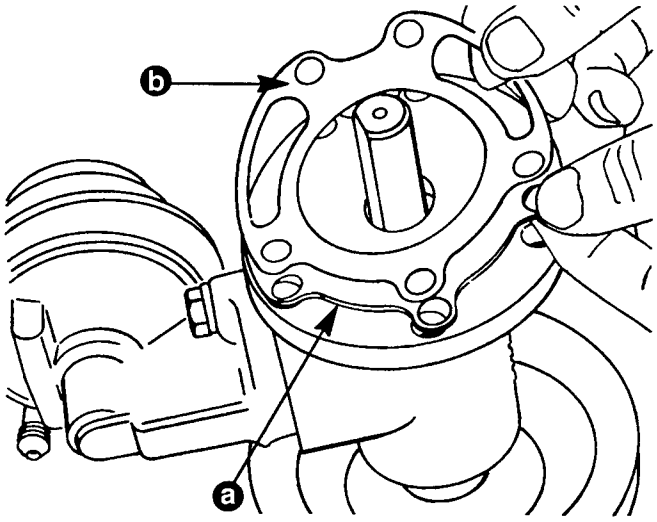
71117



71118

a - Impeller

8. Remove end plate and gasket from pump base.

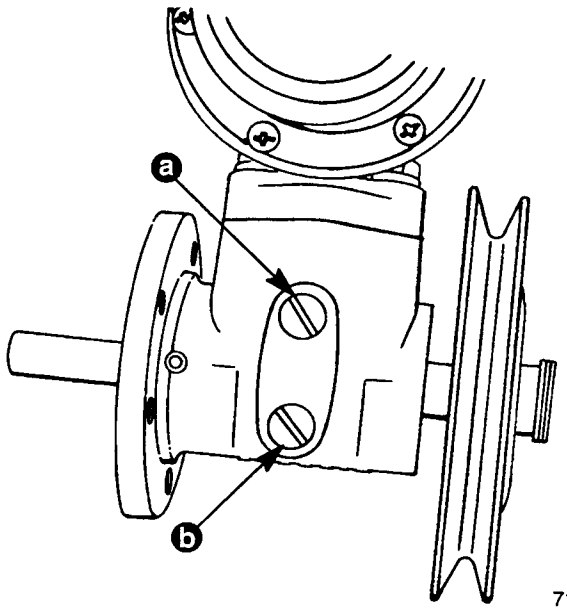


71119

a - End Plate
b - Gasket

FUEL PUMP ASSEMBLY

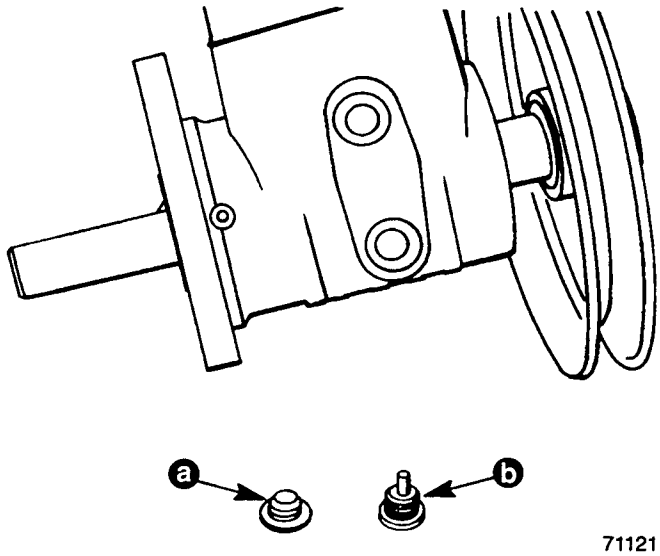
1. Remove Fill and Drain screws with sealing washers from pump housing and drain lubricant.



71120

a - Fill Screw
b - Drain Screw

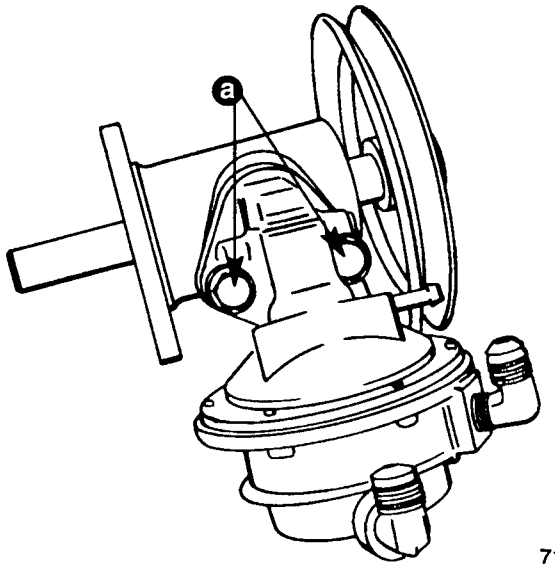
IMPORTANT: Drain screw is equipped with a magnet to attract metallic particles from inside of housing. A small amount will be present as a result of normal wear. Larger amounts of metallic particles may indicate abnormal wear.



71121

a - Fill Screw
b - Drain Screw (Magnet)

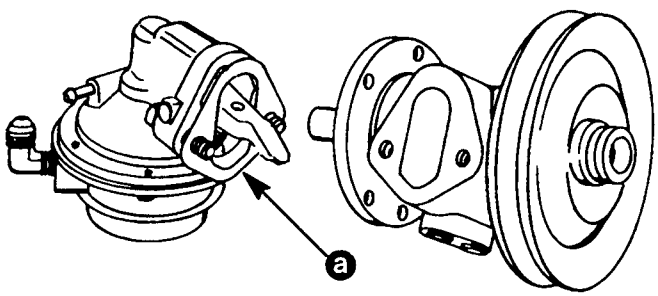
2. Remove fuel pump from housing.



71122

a - Bolts and Lockwashers (2)

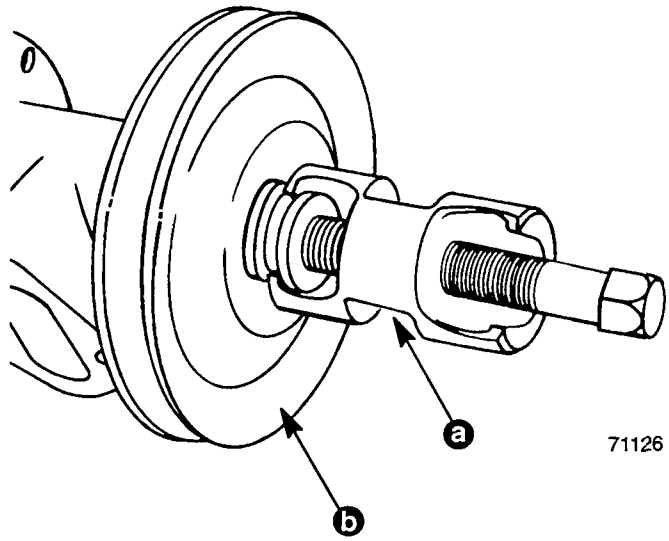
3. Remove fuel pump from housing and remove gasket.



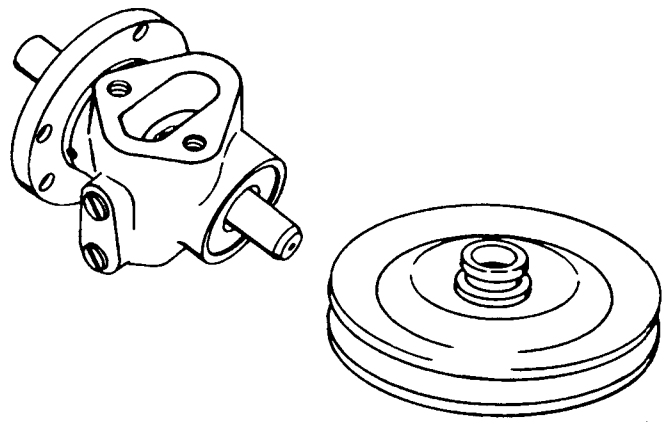
71123

a - Gasket

4. Remove pulley using appropriate puller.



71126

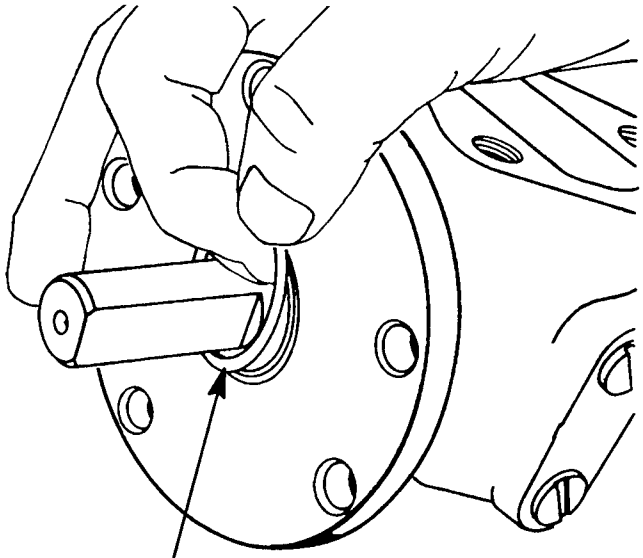


71127

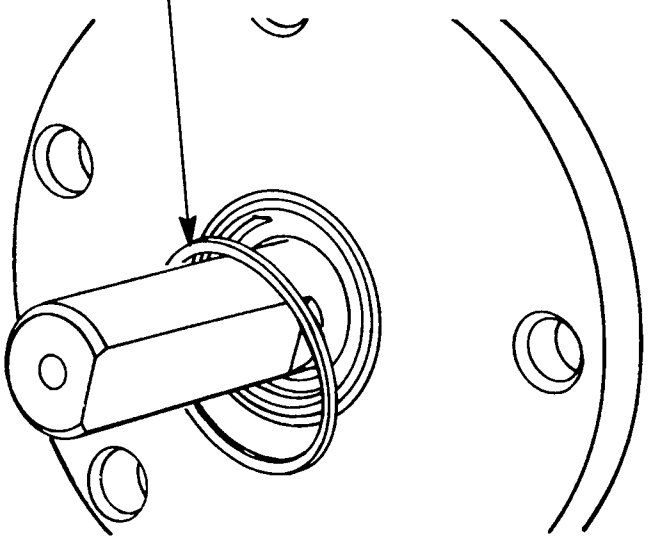
a - Puller
b - Pulley

SEAWATER/FUEL PUMP HOUSING

1. Remove quad-ring seal from water pump end of housing.



71128

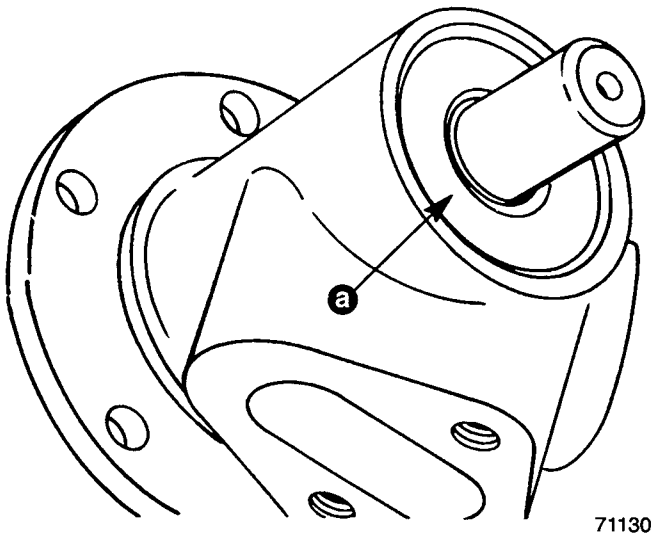


71129

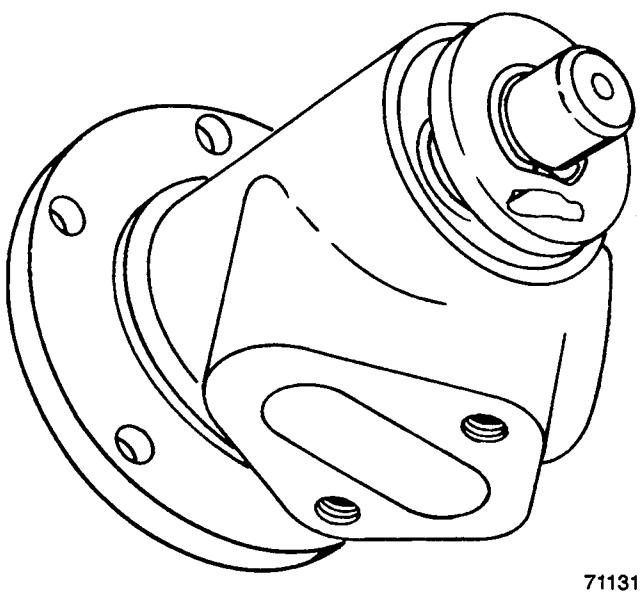
a - Quad Ring Seal

IMPORTANT: Oil seal on pulley end of housing will be damaged during removal. Do not attempt to reuse seal.

2. Remove oil seal by prying out with a screwdriver. Be careful not to damage bore.



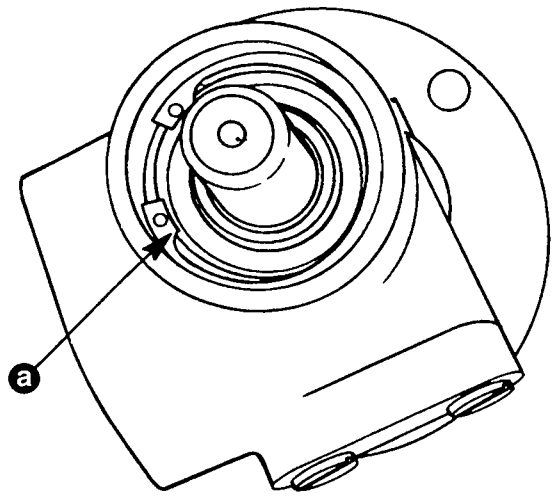
71130



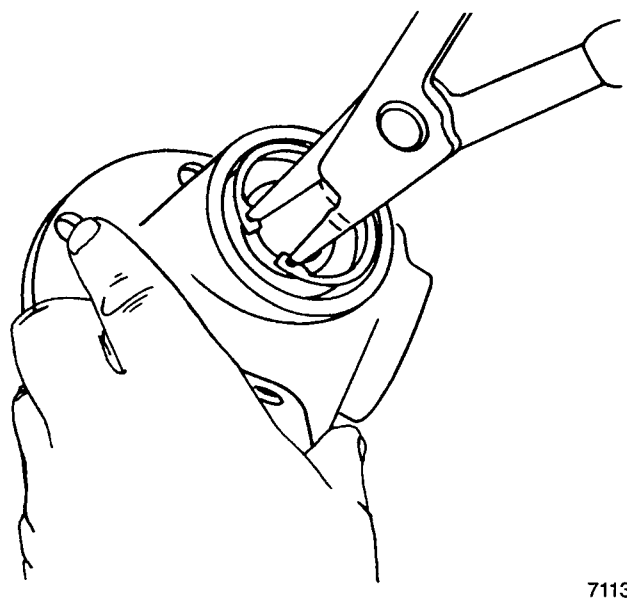
71131

a - Oil Seal

3. Remove the snap-ring that secures the shaft and bearing assembly.



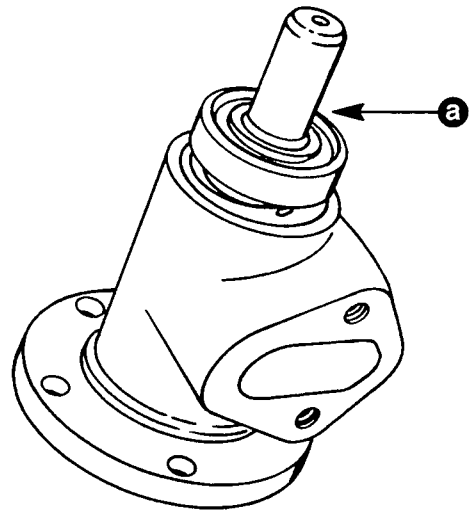
71132



71133

a - Snap Ring

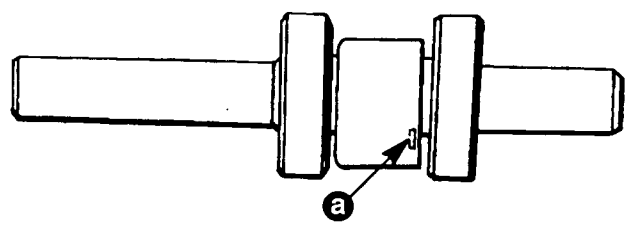
4. Lift shaft and bearing assembly from housing.



71134

a - Shaft and Bearing Assembly

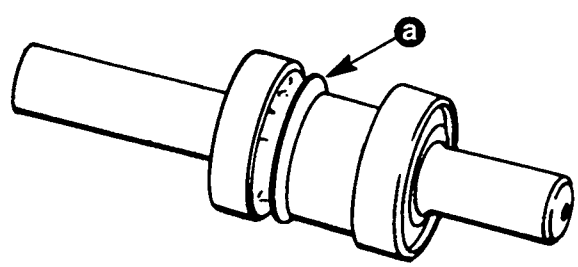
NOTE: Shaft assembly could be equipped with one of two different style of slip-rings. The earlier style slip-ring is secured to the cam by dimples on the edge of the ring. The later style does not have dimples but does have a washer that rides against the cupped end of the slip-ring.



71135

a - Dimples

EARLIER STYLE WITH DIMPLED SLIP-RING

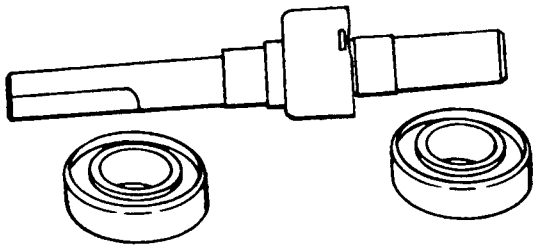


71139

a - Washer

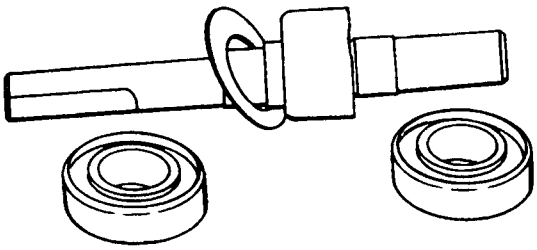
LATER STYLE WITH WASHER

5. Remove bearings from shaft using a universal puller plate.



71136

VERSION WITH EARLIER STYLE SLIP-RING

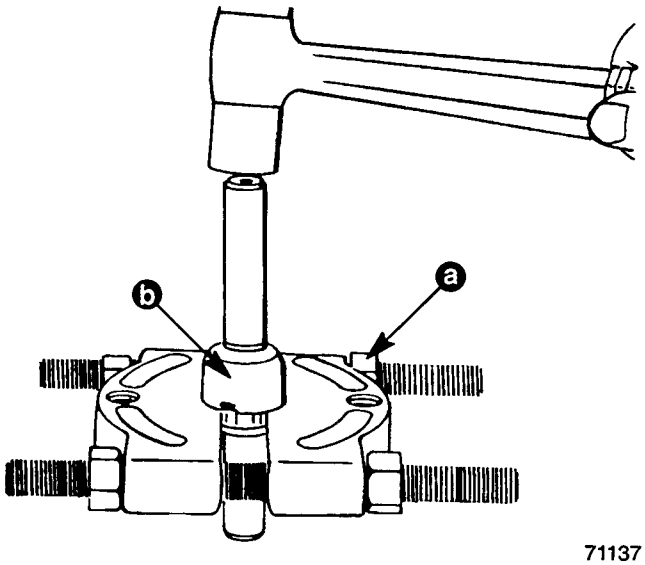


71140

VERSION WITH LATER STYLE SLIP-RING

IMPORTANT: Early slip-rings with dimples can not be reinstalled after removal. Do not remove early style dimpled slip-ring unless replacing.

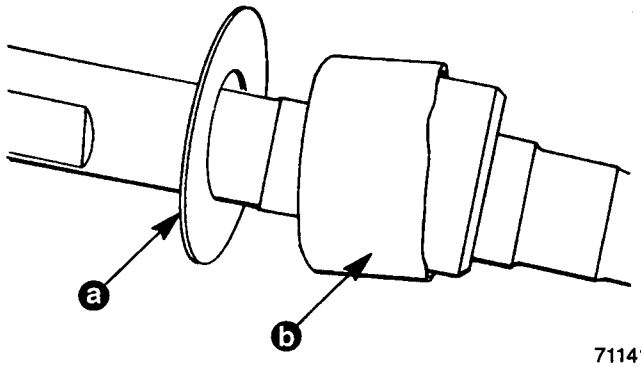
6. **Models with Earlier Style Slip-Ring:** Remove slip-ring by supporting it at its outer edge and lightly tapping on end of shaft with a soft hammer. Be careful not to damage cam surface



71137

a - Universal Puller Plate
b - Slip Ring

7. **Models with Later Style Slip-Ring:** Slide washer and slip-ring off of shaft.

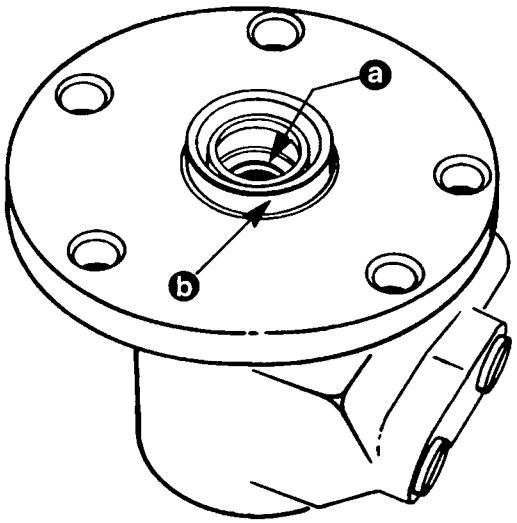


71141

a - Washer
b - Slip-Ring

IMPORTANT: Oil and water seals on water pump end of housing will be damaged during removal. Do not attempt to reuse these seals.

8. Remove outer (water) seal and inner (oil) seal by prying out or by tapping out using a suitable mandrel. Be careful not to damage bore.



71142

a - Inner (Oil) Seal
b - Outer (Water) Seal

Cleaning and Inspection

⚠CAUTION

Always wear safety glasses when using compressed air.

1. Clean metal parts in solvent and blow dry with compressed air.

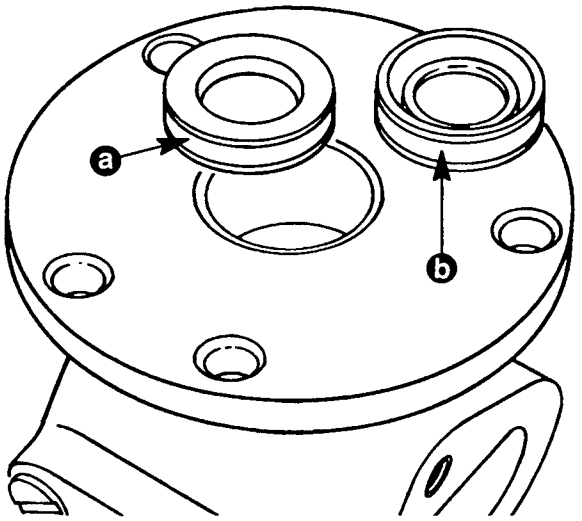
IMPORTANT: Do not spin bearings at high speed when drying with compressed air, as bearings may be scored.

2. After cleaning, apply a coat of light engine oil to shaft and bearings to prevent rust.
3. Clean all gasket material and sealer from sealing surfaces.
4. Inspect bearing housing. Examine surfaces (where bearings contact housing) for evidence of bearing outer races turning in housing.
5. Inspect seals in bearing housing.
6. Inspect pump shaft bearings.
7. Inspect pump shaft for grooves in surface where seals contact shaft. Inspect keyway in shaft. Also, inspect surface, where bearings contact shaft, for evidence of inner races turning on shaft.
8. Inspect impeller drive key.
9. Inspect pump body.
10. Inspect inner and outer wear plate.

Reassembly

SEAWATER/FUEL PUMP HOUSING

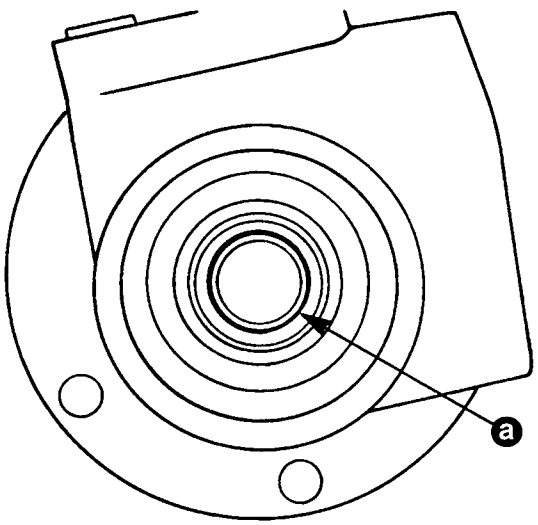
IMPORTANT: Seals in water pump end of housing must be facing in the proper direction. The lip on inner (oil) seal must be facing inward toward oil pump. The lip on outer (water) seal must be facing outward toward the water pump.



71143

a - Inner (Oil) Seal – Lip Inward Toward Oil Pump
b - Outer (Water) Seal – Lip Outward Toward Water Pump

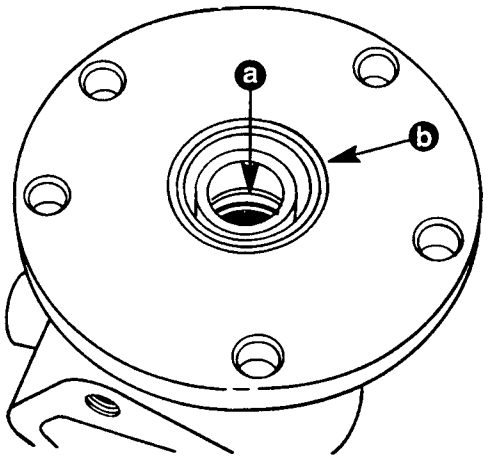
1. Apply a light coat of Loctite 514 to O.D. of seal and install inner (oil) seal using a suitable mandrel. Seal is properly positioned when edge of seal is even with edge of bore.



71144

a - Inner (Oil) Seal

2. Apply a light coat of Loctite 514 to O.D. of seal and install outer (water) seal using a suitable mandrel. Seal is properly positioned when edge of seal is flush with face of housing. Do not install seal deeper. Fill cavity between the two seals with Quicksilver Special Lubricant 101.



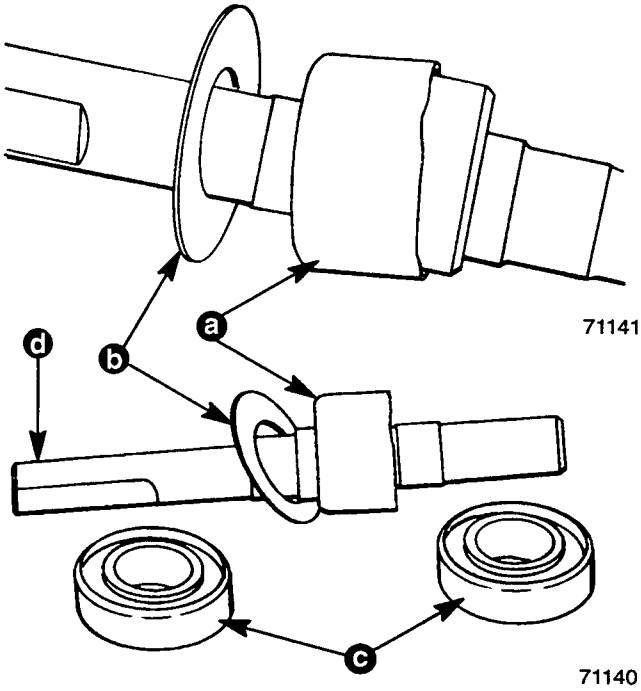
71145

a - Outer (Water) Seal
b - Face of Housing

3. Reassemble shaft and bearing assembly as follows:
   a. Lubricate all shaft components and bearings with Quicksilver High Performance Gear Lube.

IMPORTANT: Early slip-rings with dimples can not be reinstalled after removal. Replacement parts are as shown following.

   b. Place slip-ring and washer over shaft from water pump impeller end.

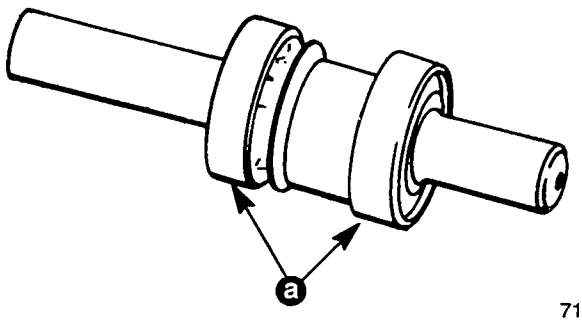


71141

71140

a - Slip-Ring
b - Washer
c - Bearings
d - Water Pump Impeller End

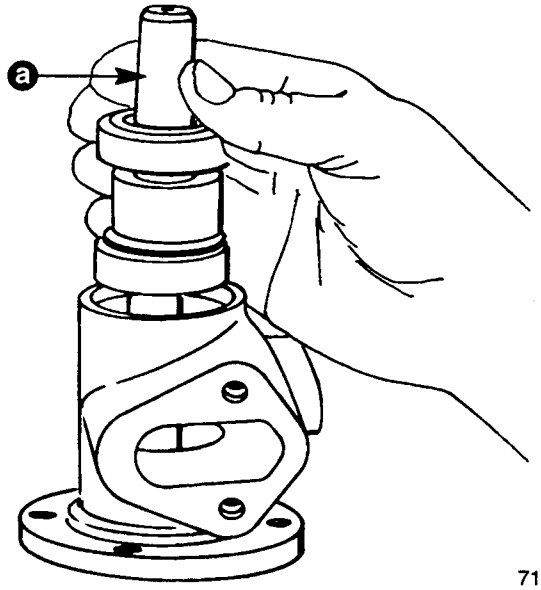
   c. Press bearings onto shaft until seated.



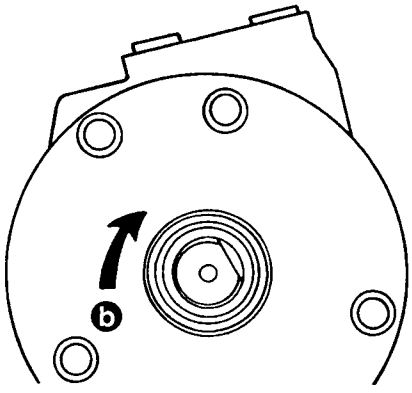
71139

a - Bearings

4. Lower shaft and bearing assembly into housing. Use care when guiding shaft through oil and water seals to avoid turning over seal lips. To avoid this, rotate shaft as it is lowered through seals.



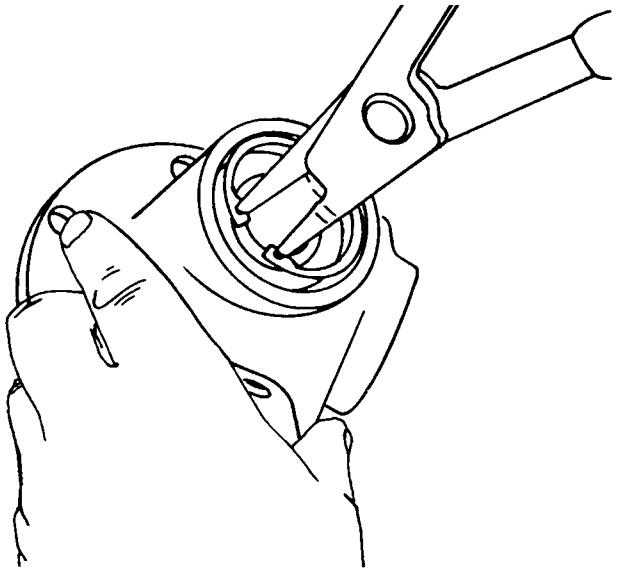
71146



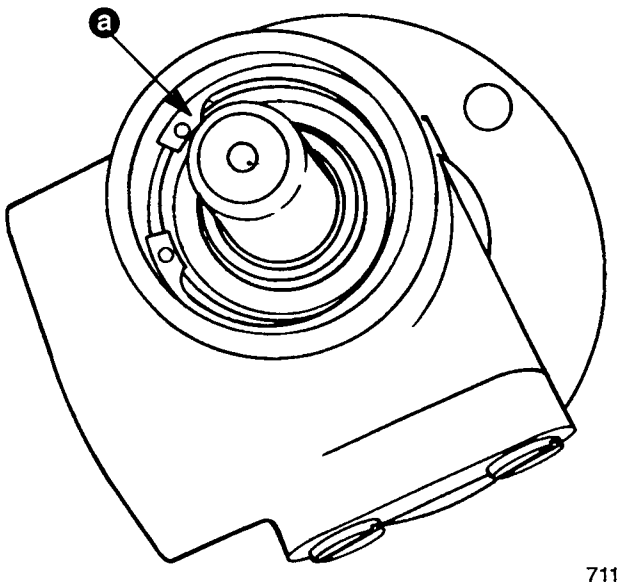
71147

a - Shaft and Bearing Assembly
b - Rotate When Moving thru Seals

5. Push shaft and bearing assembly down until seated. Shaft is properly seated when the snap-ring groove is visible above the outer bearing.
6. Install snap-ring to secure shaft and bearing assembly.



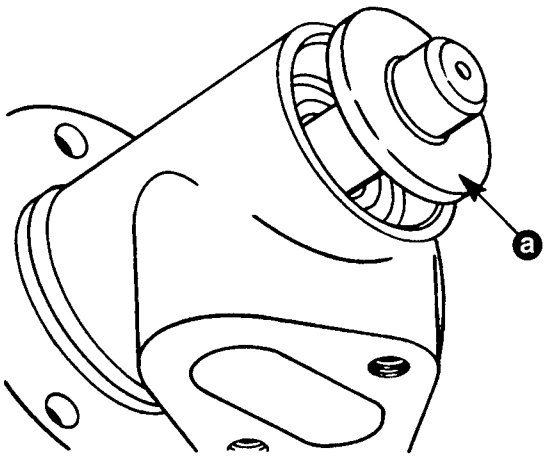
71133



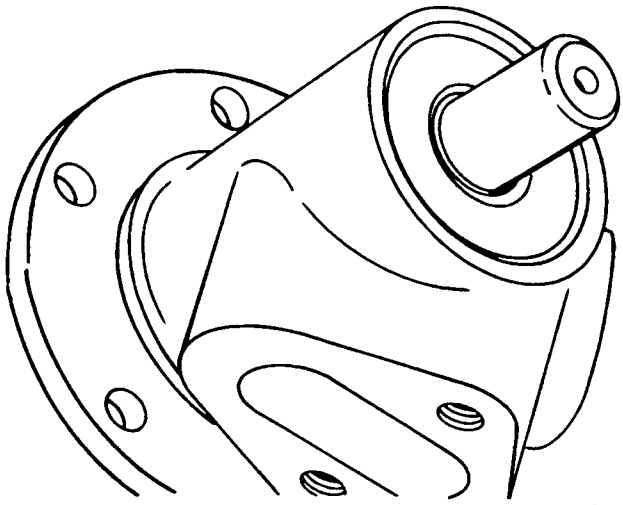
71132

a - Snap Ring

7. Apply a light coat of Loctite 514 to O.D. of seal and install oil seal on pulley end of housing using a suitable mandrel. Seal lip should be facing inward toward snap-ring. Lubricate lip of seal with Quicksilver Special Lubricant 101. Seal is properly positioned when it bottoms.



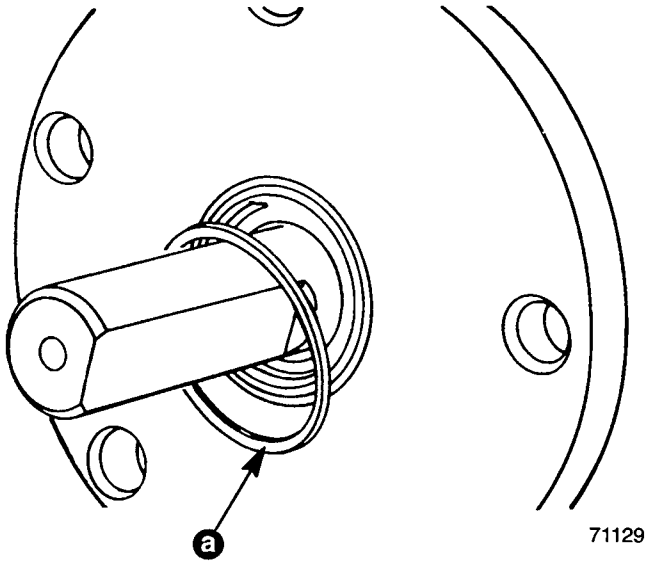
71148



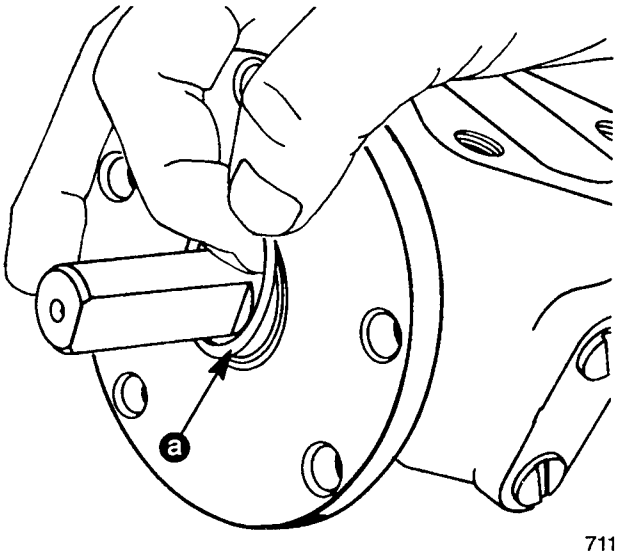
71130

a - Oil Seal – Lip Toward Snap Ring

8. Install quad-ring seal on water pump end of housing.



71129



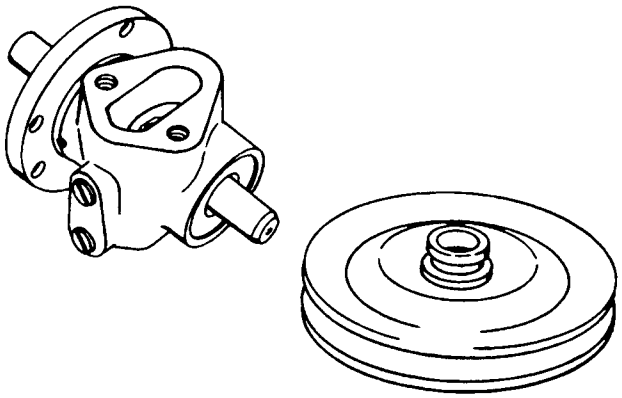
71128

a - Quad-Ring Seal

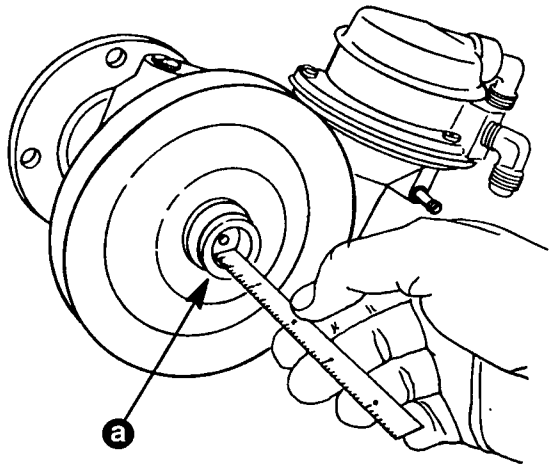
FUEL PUMP ASSEMBLY

IMPORTANT: Pulley must be pressed on exactly as described in the following step to avoid rapid belt wear.

1. Carefully press pulley onto shaft. Pulley is properly positioned when end of shaft is located 1/2 in. (13mm) from front edge of pulley.



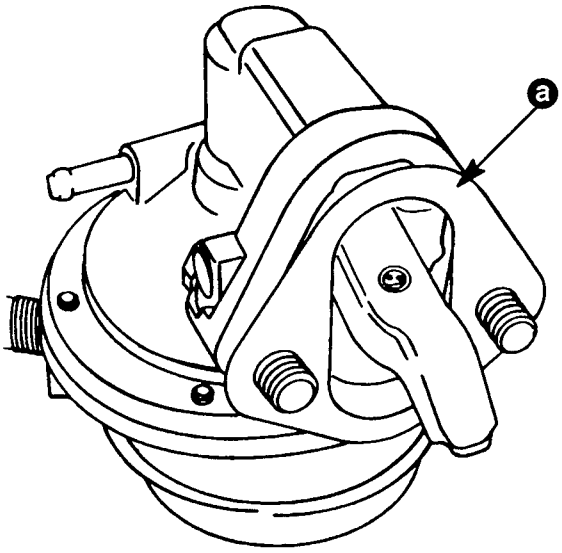
71127



71149

a - Pulley 1/2 in. (13mm) Measurement

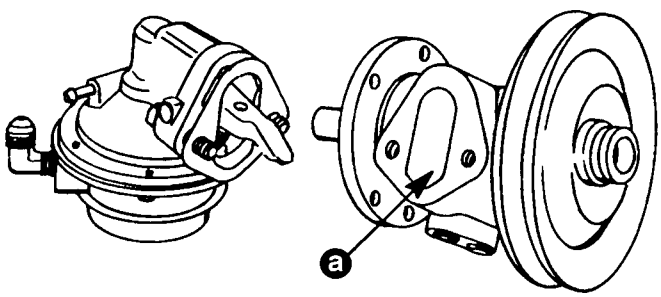
2. Apply a light coat of Quicksilver Perfect Seal to fuel pump gasket. Position gasket on fuel pump.



71124

a - Gasket

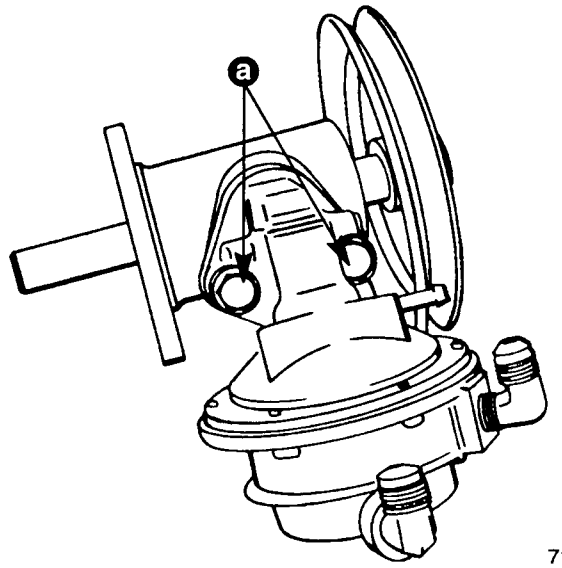
3. Turn on pulley to bring the low spot of fuel pump cam toward fuel pump lever.



71123

a - Fuel Pump Cam

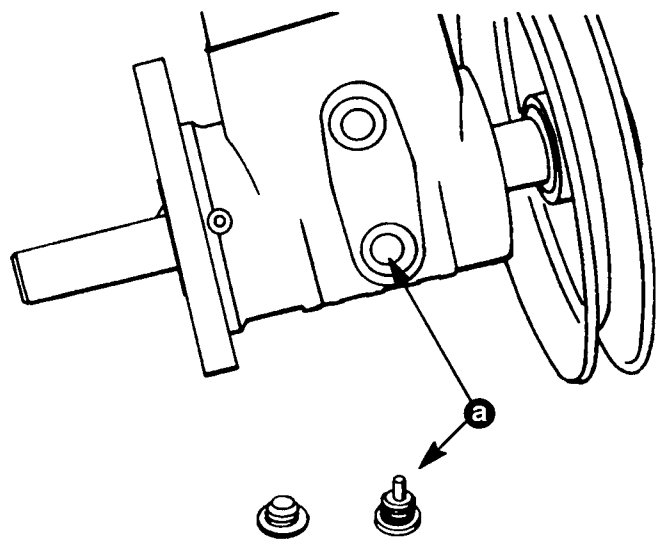
4. Install fuel pump on housing. Secure with bolts and lockwashers. Torque to 25-28 lb. ft. (34-38 N·m).



71122

a - Bolts and Lockwashers (2)

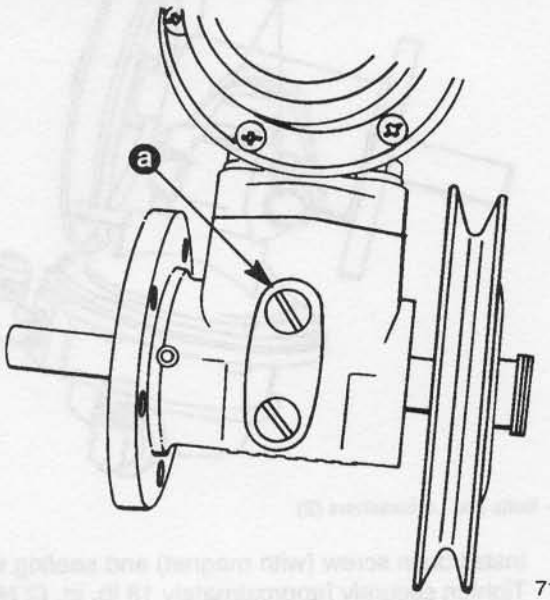
5. Install drain screw (with magnet) and sealing washer. Tighten securely [approximately 18 lb. in. (2 N·m)].



71121

a - Drain Screw (with Magnet)

6. Fill fuel pump housing with Quicksilver High Performance Gear Lube. Gear lube level should come up to bottom edge of top hole. Install fill screw with sealing washer and tighten securely [approximately 18 lb. in. (2 N·m)].

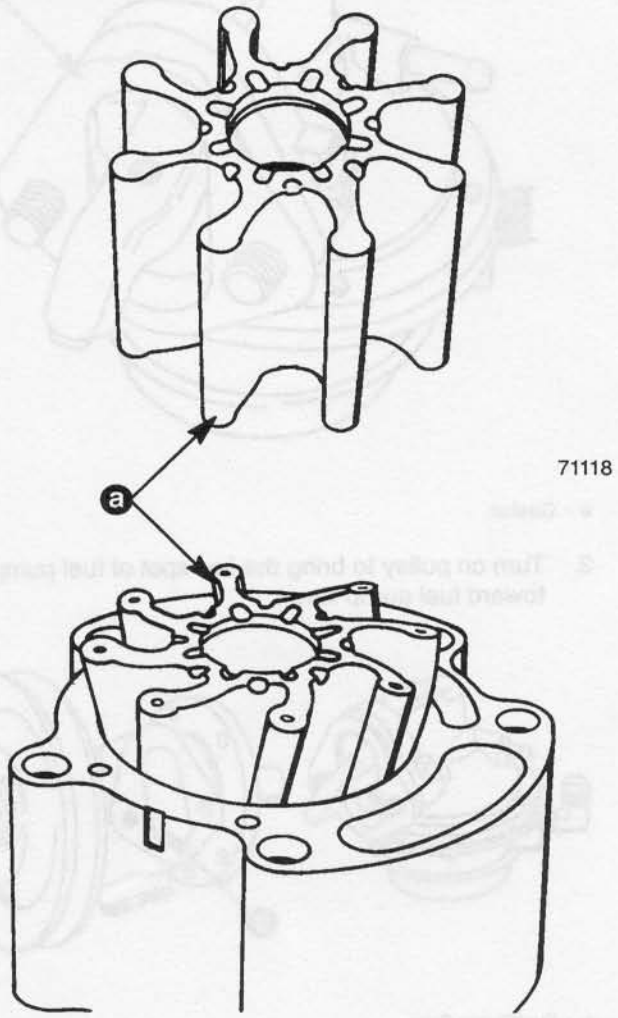


71120

a - Fill Screw

SEAWATER PUMP ASSEMBLY

1. Lubricate seawater pump impeller with a water and soap solution. Install impeller into housing by rotating and pushing it into place. Push it down until flush with housing.

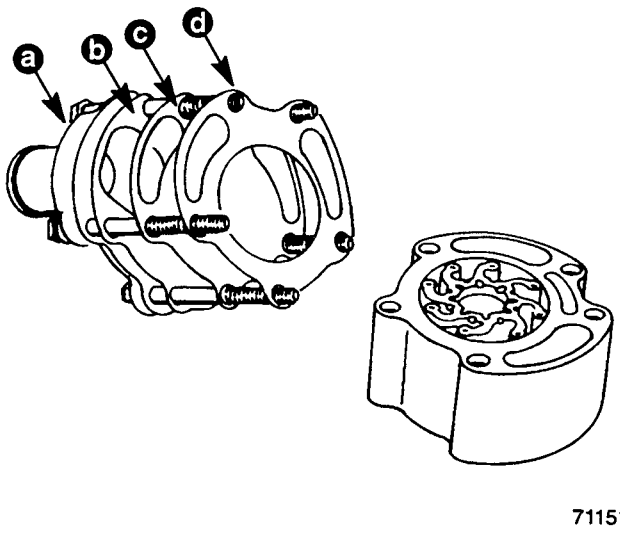


71118

71150

a - Impeller

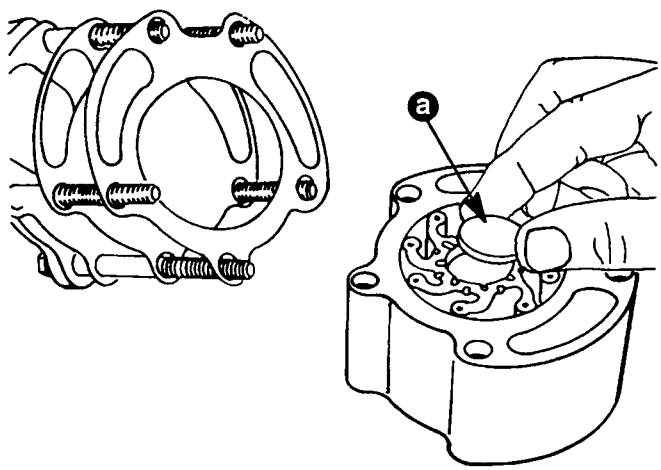
2. Install bolts with flat washers thru water pump end cover. Position gaskets and wear plate as shown.



71151

a - End Cover
b - Gasket (with Two Openings)
c - Wear Plate
d - Gasket (with Large Opening)

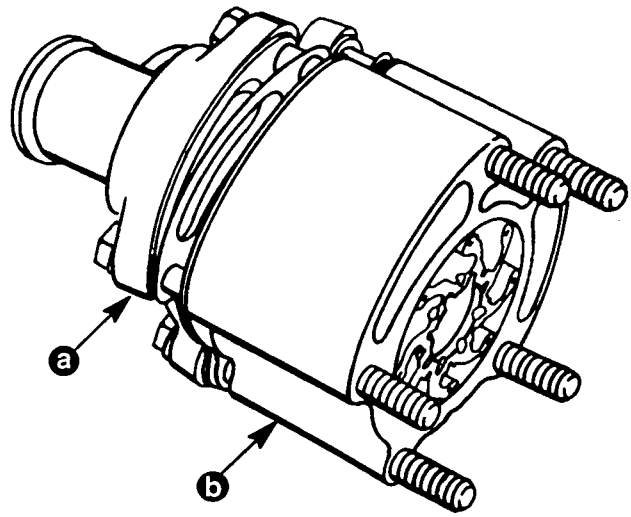
3. Place rubber plug in end of impeller that will be facing end cover.



71152

a - Rubber Plug

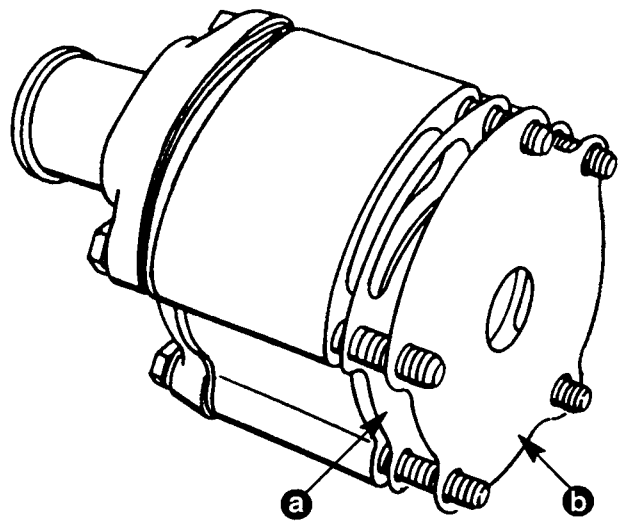
4. Slide water pump housing over bolts and join to end cover.



71153

a - End Cover
b - Water Pump Housing

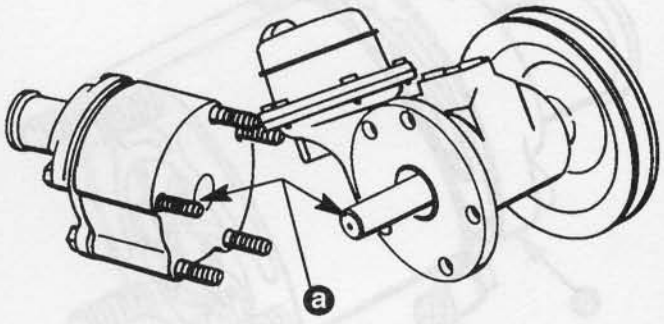
5. Place gasket and wear plate over bolts and slide up against housing.



71154

a - Gasket (with Large Opening)
b - Wear Plate

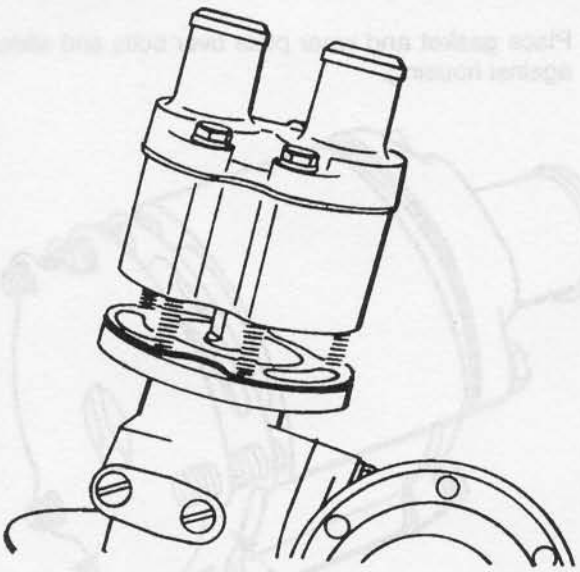
6. Rotate shaft so that flat spot on shaft will be in the approximate position to line up with flat spot inside impeller.



71155

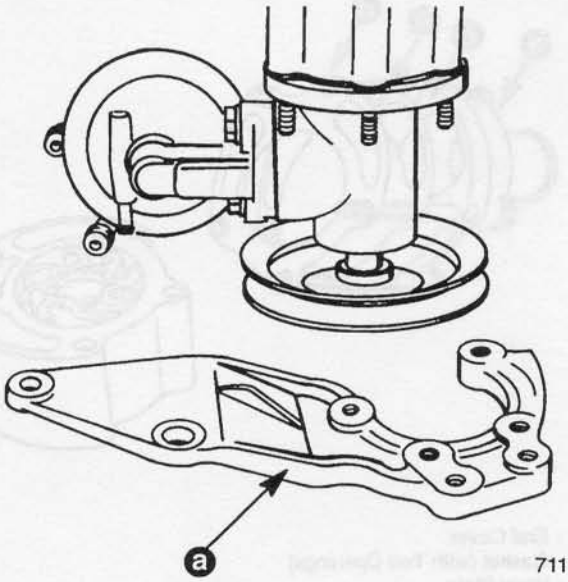
a - Flat Spot on Shaft

7. While holding wear plate and gasket up against housing, carefully lower water pump assembly down onto shaft. Rotate assembly from side-to-side to align shaft and impeller.

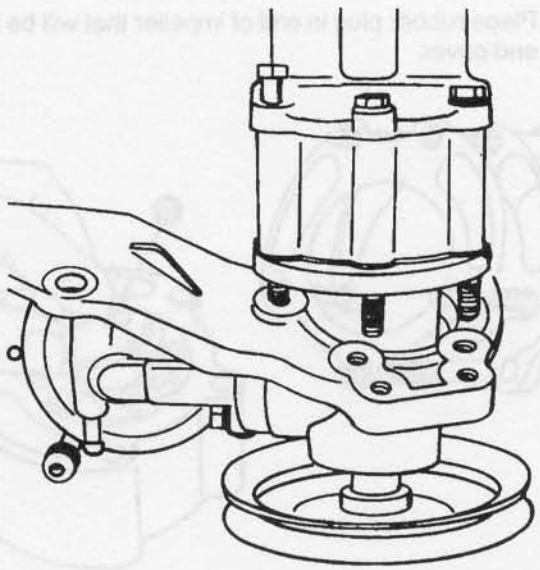


71156

8. Position main bracket as shown and install. Secure the water pump assembly to the bracket with four of the five bolts.



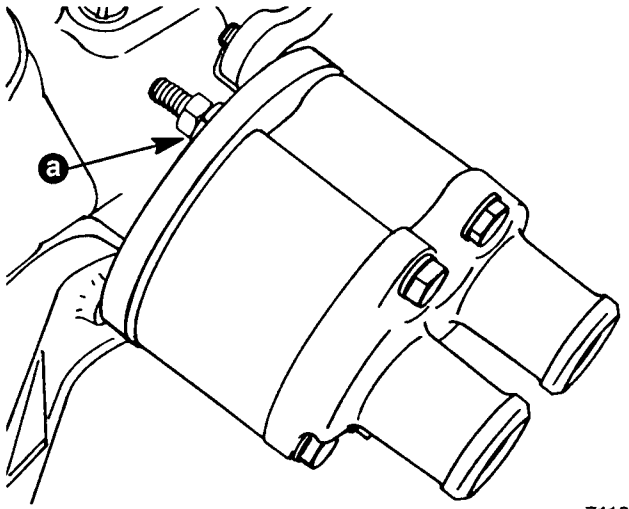
71111



71110

a - Bracket

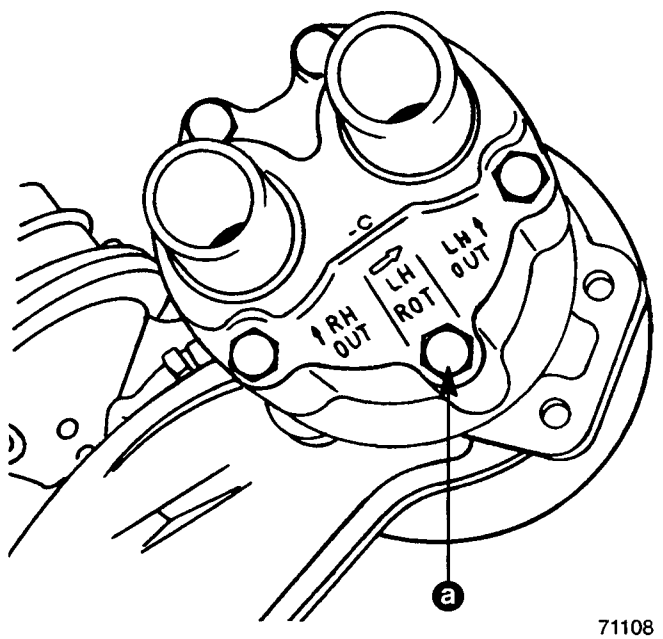
9. Secure the fifth bolt with a nut and lockwasher.



71109

a - Nut and Lockwasher

10. Torque all of these fasteners to 10-15 lb. ft. (14-20 N·m).

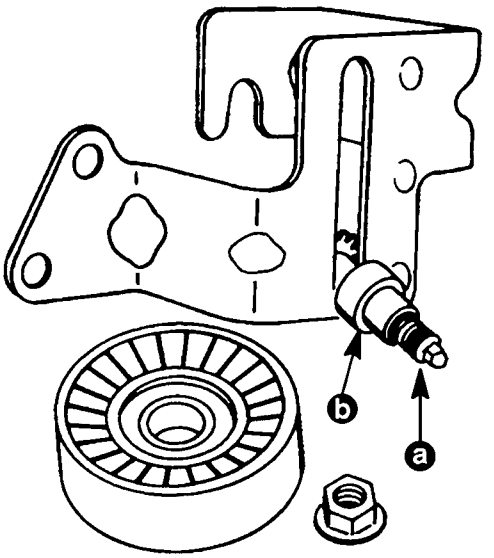


71108

a - Bolts

IDLER PULLEY ASSEMBLY

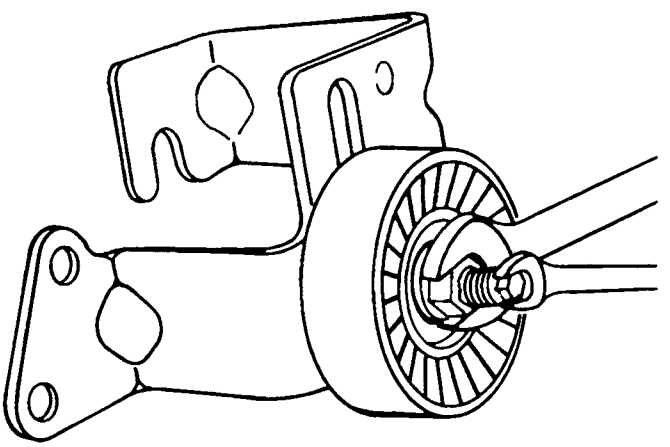
1. Install idler pulley adjusting bolt and bushing.



71106

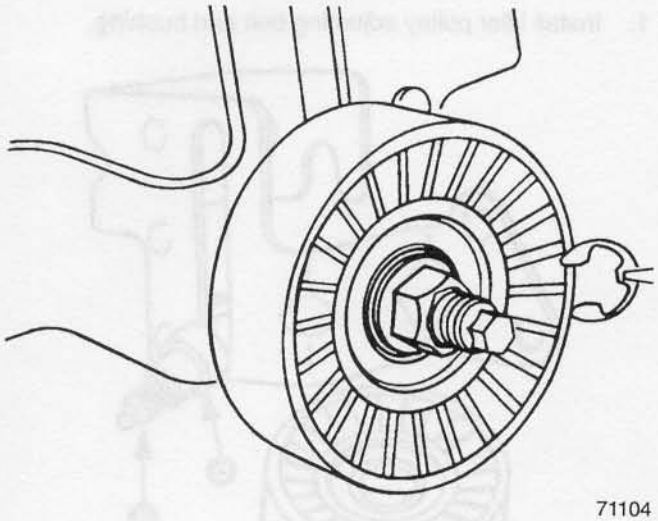
a - Adjusting Bolt
b - Bushing

2. Install idler pulley and secure with locknut. Tighten locknut while holding adjusting bolt. Do not tighten completely at this time as adjustment will be necessary when installing belt.

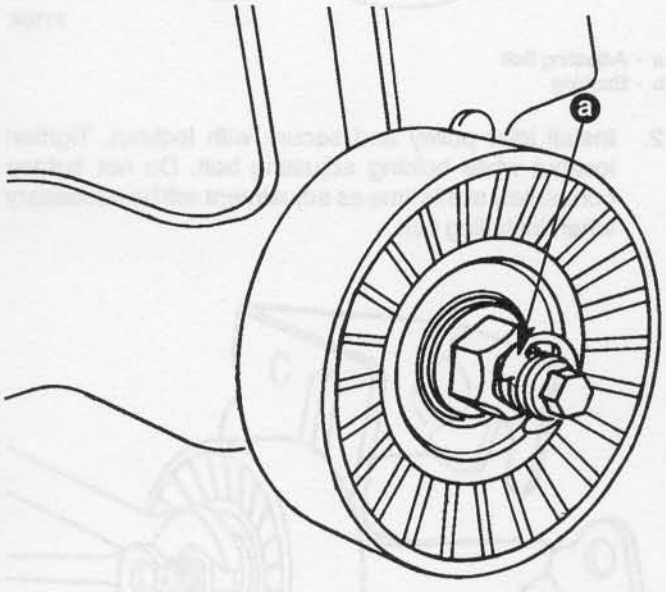


71105

3. Install retaining clip on adjusting bolt.



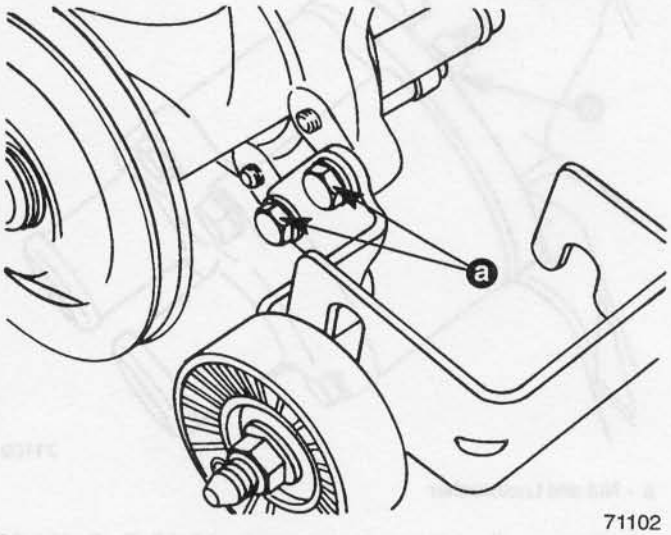
71104



71103

a - Retaining Clip

4. Install idler assembly bracket on pump housing. Secure with bolts and lockwashers. Torque to 30-35 lb. ft. (41-47 N·m).

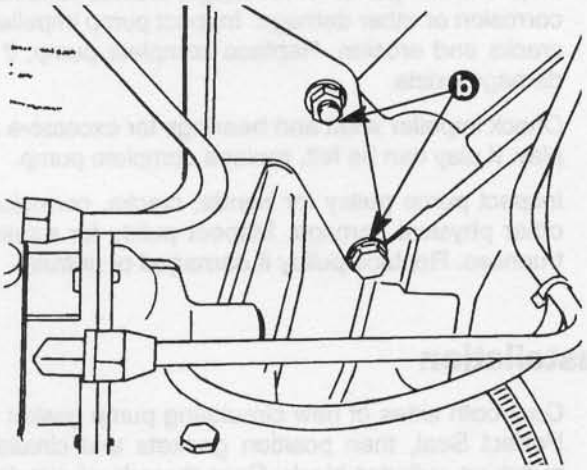


71102

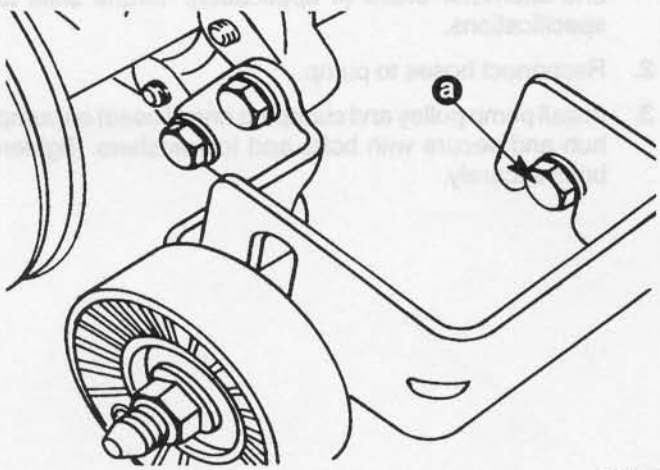
a - Bolts and Lockwashers (2)

Installation

1. Install seawater/fuel pump assembly. Secure with bolts and lockwashers as shown. Torque to 30 lb. ft. (41 N·m).



71161



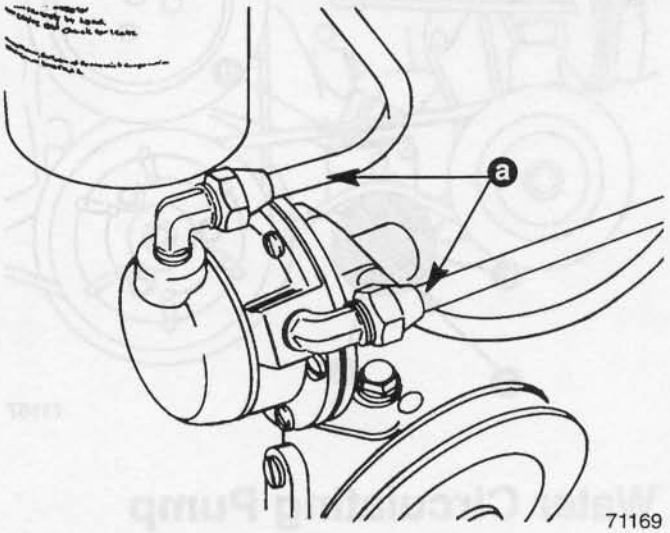
71102

a - Idler Bracket Bolt
b - Main Bracket Bolts (2)

⚠ WARNING

Be careful when working on fuel system components. Gasoline is extremely flammable under certain conditions. Be sure ignition key is OFF. Do not smoke or allow spark or open flame in area when working on fuel system components. Wipe up any spilled fuel immediately.

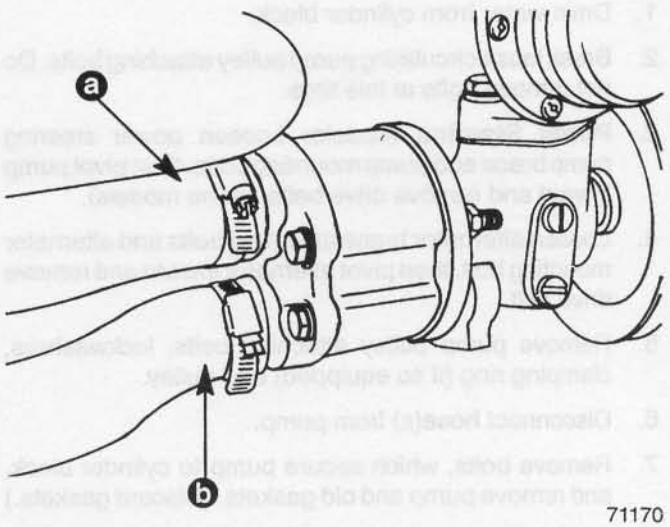
2. Connect fuel lines to fuel pump and tighten securely.



71169

a - Fuel Lines

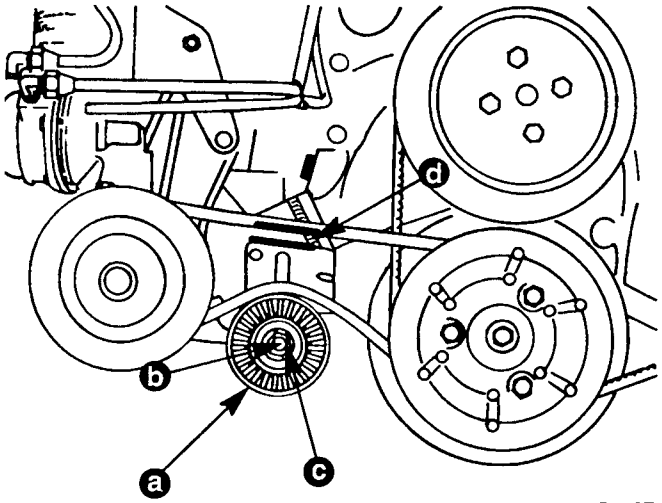
3. Connect water hoses to seawater pump.



71170

a - Inlet Hose
b - Hose to Cooler

4. Install drive belt in appropriate configuration. Adjust belt tension using the adjusting bolt and locknut. When adjustment is correct, torque locknut to 30 lb. ft. (41 N·m). Tension is checked by pushing on belt in area opposite the idler pulley. Belt should depress approximately 1/4 in. (6mm).



71167

Water Circulating Pump Replacement

Removal

1. Drain water from cylinder block.
2. Break loose circulating pump pulley attaching bolts. Do not remove bolts at this time.
3. **Power Steering Models:** Loosen power steering pump brace and pump mounting bolts, then pivot pump inward and remove drive belts (some models).
4. Loosen alternator brace attaching bolts and alternator mounting bolt, then pivot alternator inward and remove drive belt.
5. Remove pump pulley attaching bolts, lockwashers, clamping ring (if so equipped) and pulley.
6. Disconnect hose(s) from pump.
7. Remove bolts, which secure pump to cylinder block, and remove pump and old gaskets. (Discard gaskets.)

Cleaning and Inspection

1. Clean gasket surfaces on water pump and cylinder block.
2. Inspect water pump for blockage, cracks, sand holes, corrosion or other damage. Inspect pump impeller for cracks and erosion. Replace complete pump, if any damage exists.
3. Check impeller shaft and bearings for excessive side play. If play can be felt, replace complete pump.
4. Inspect pump pulley for bends, cracks, corrosion or other physical damage. Inspect pulley for rotational trueness. Replace pulley if damaged or untrue.

Installation

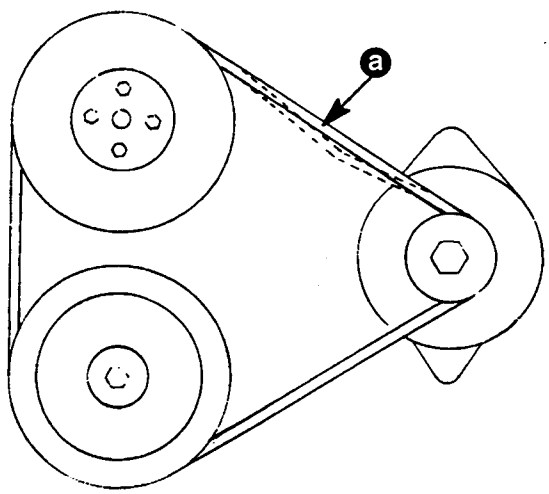
1. Coat both sides of new circulating pump gasket with Perfect Seal, then position gaskets and circulating pump on cylinder block. Coat threads of circulating pump attaching bolts with Perfect Seal and install bolts and alternator brace (if applicable). Torque bolts to specifications.
2. Reconnect hoses to pump.
3. Install pump pulley and clamping ring (if used) on pump hub and secure with bolts and lockwashers. Tighten bolts securely.

4. Install drive belts and adjust tension as outlined in "Drive Belt Tension Adjustment" (see Table of Contents).
5. If engine is equipped with Closed Cooling, fill closed cooling section with coolant in accordance with Section 6, Part B "Filling Instructions."
6. Start engine and check for leaks.

Drive Belt Tension Adjustment

Alternator

1. Install drive belt on pulleys and adjust tension as follows:
   a. Pivot alternator away from engine, as required, until correct tension is obtained as shown.
   b. After obtaining correct tension, securely retighten alternator brace attaching bolts and alternator mounting bolt.



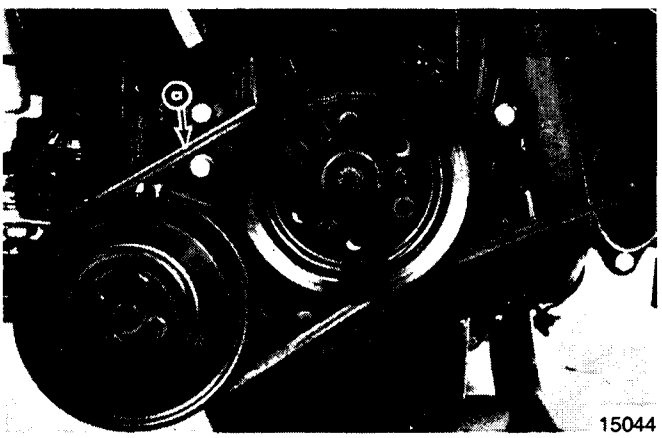
a - Belt Should Depress 1/2" (13mm)

Alternator Drive Belt Tension

2. If a new drive belt has been installed, recheck belt tension after running for 5 minutes.

Belt Driven Seawater Pickup Pump Without Combination Fuel Pump

1. Install drive belt on pulleys and adjust tension as follows:
   a. Pivot pump away from engine, as required, until correct tension is obtained as shown.
   b. After obtaining correct tension, securely retighten pump brace and pump mounting bolts.



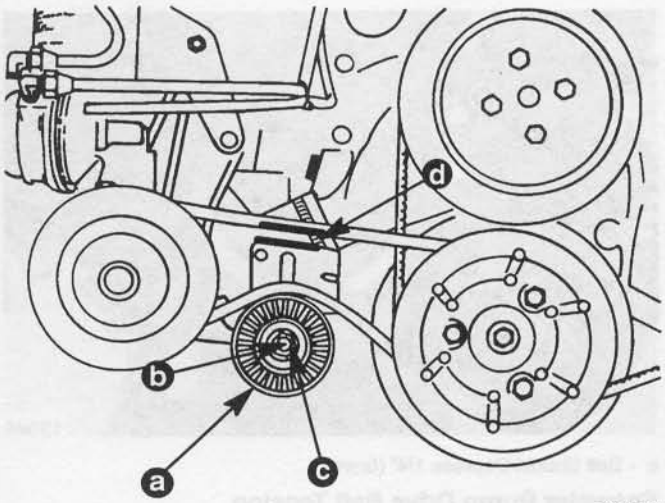
a - Belt Should Depress 1/4" (6mm)

Seawater Pump Drive Belt Tension

2. If a new drive belt has been installed, recheck belt tension after running for 5 minutes.

Belt Driven Seawater Pickup Pump With Combination Fuel Pump

1. Install drive belt.
2. Adjust belt tension using the adjusting bolt and locknut. When adjustment is correct, torque locknut to 30 lb. ft. (41 N·m). Tension is checked by pushing on belt in area opposite the idler pulley. Belt should depress approximately 1/4 in. (6mm).



71167

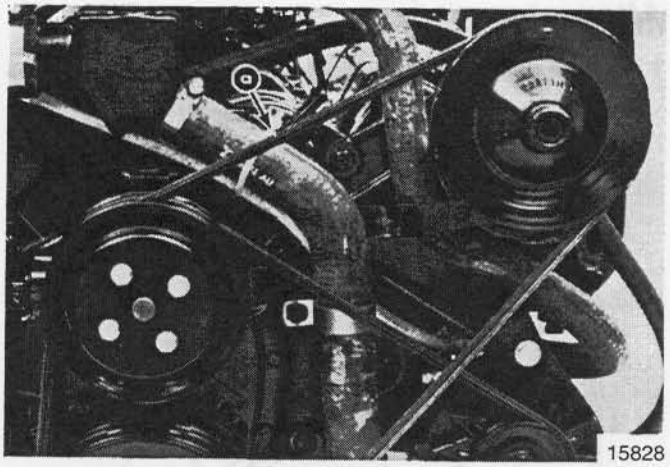
a - Idler Pulley
b - Adjusting Bolt
c - Locknut
d - Belt Deflection Measurement

LEFT-HAND ROTATION ENGINES

Power Steering Pump

IMPORTANT: Do not pry on pump with pry bar or screwdriver.

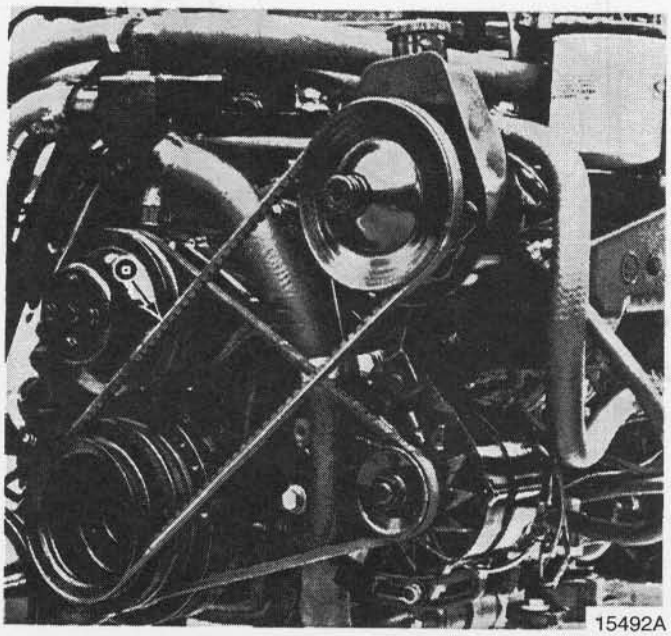
1. Install drive belt on pulleys and adjust tension as shown in the following photos.
   a. Pivot pump away from engine, as required, until correct tension is obtained as shown.
   b. After obtaining correct tension, securely retighten pump brace and pump mounting bolts.
2. If a new drive belt has been installled, recheck belt tension after running for 5 minutes.



15828

a - Belt Should Depress 1/4" (6mm)

305/350 CID Models



15492A

a - Belt Should Depress 1/2" (13mm)

454/502 CID Models

Flushing Seawater Cooling System

If engine is operated in salty, polluted or mineral-laden waters, seawater cooling system should be flushed periodically (preferably after each use) with fresh water to reduce corrosion and prevent the accumulation of deposits in the system. Seawater cooling system also should be thoroughly flushed prior to storage.

⚠ WARNING

When flushing, be certain the area around propeller is clear, and no one is standing nearby. To avoid possible injury, remove propeller.

⚠ CAUTION

Do not run engine above 1500 RPM when flushing. Suction created by seawater pickup pump may collapse flushing hose, causing engine to overheat.

IMPORTANT: If cooling system is to be flushed with boat in the water, seacock (if so equipped) must be closed, or water inlet hose must be disconnected and plugged to prevent water from flowing into boat.

⚠ CAUTION

Watch temperature gauge at dash to ensure the engine does not overheat.

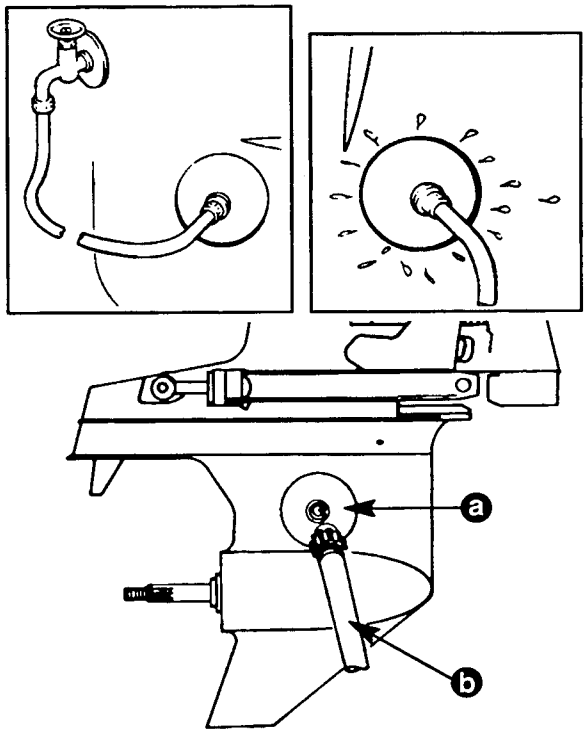
Stern Drive Unit Seawater Pickup Pump Engines

⚠ CAUTION

To prevent engine or stern drive unit damage DO NOT run engine or drive unit without water being supplied to water intake openings on gear housing.

If flushing cooling system with boat in water, raise drive unit to trailer position, install flushing attachment and lower drive unit to full down/in position.

1. Install Quicksilver flushing attachment (or equivalent) over water intake openings in gear housing.
2. Connect hose between flushing attachment and water tap.



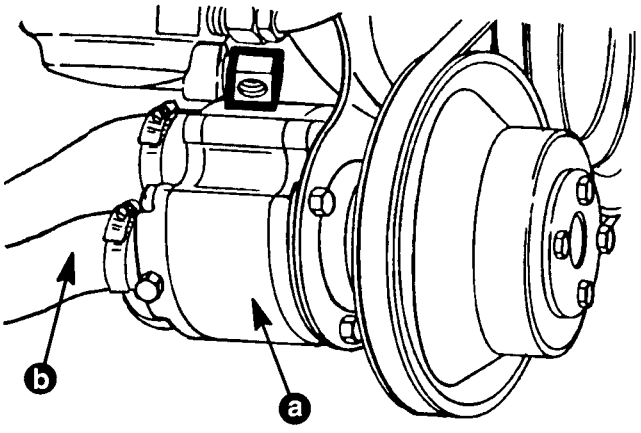
a - Flush Device
b - Garden Hose

Flush Device on Stern Drive

3. With drive unit in normal operating position, partially open water tap (about 1/2 maximum) and allow cooling system to fill completely. Cooling system is full when water is discharged through the propeller. Do not use full tap water pressure.
4. Place remote control in NEUTRAL, idle speed position and start engine. Operate engine at idle speed, in NEUTRAL, for about 10 minutes, or until discharge water is clear. Watch temperature gauge on instrument panel to ensure that engine does not overheat.
5. Stop engine. Shut off tap water and remove flushing attachment.

Belt Driven Seawater Pickup Pump

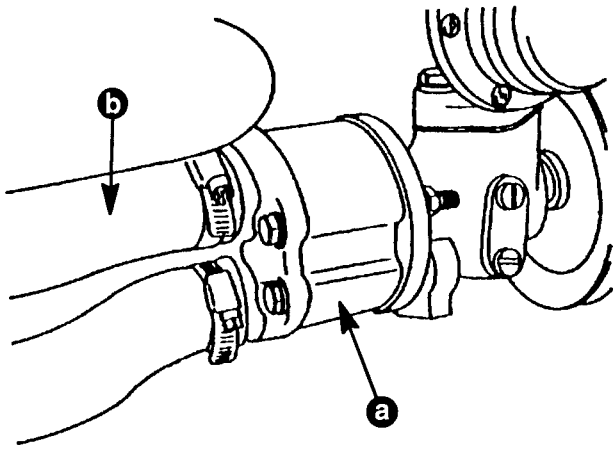
1. Close seacock (if equipped) or remove and plug seawater inlet hose.
2. Loosen hose clamp and remove seawater inlet hose at location shown.



72352

Seawater Pump Without Combination Fuel Pump

a - Seawater Pickup Pump
b - Seawater Pump Inlet Hose



71170

Seawater Pump With Combination Fuel Pump

a - Seawater Pickup Pump
b - Seawater Pump Inlet Hose

3. Partially open water tap (approx. 1/2 maximum capacity) and allow cooling system to fill completely. Cooling system is full when water is discharged thru the exhaust. Do not use full water tap pressure.
4. Place the remote control lever in neutral position and start the engine. Operate engine at idle speed in neutral gear for 10 minutes or until discharge water is clear, then stop engine.

⚠CAUTION

If boat is in the water, seacock (if so equipped) must be left closed until engine is to be restarted, to prevent water from flowing back into cooling system. If boat is not fitted with a seacock, water inlet hose must be left disconnected and plugged, to prevent water from flowing into cooling system and/or boat. As a precautionary measure, attach a tag to the ignition switch or steering wheel with the warning that the seacock must be opened or the water inlet hose reconnected prior to starting the engine.

5. Shut off tap water. Remove flushing connector from pump inlet. Refer to preceding precautionary statement and then follow instructions "a" or "b":
   a. **If equipped with seacock:** Reconnect water inlet hose and tighten hose clamp securely. Open seacock accordingly.
   b. **If NOT equipped with seacock:** Unplug and reconnect seawater inlet hose accordingly. Tighten hose clamp securely.

Check/Clean Seawater Strainer

NOTICE

Refer to manufacturer's instructions for information on checking and cleaning of other than Quicksilver Sea Strainer.

1. Visually inspect seawater strainer thru glass top.

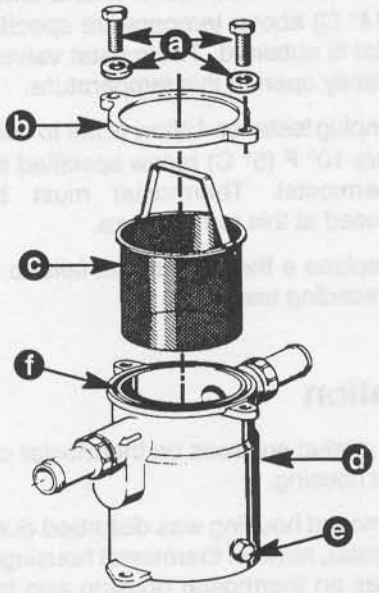
⚠ WARNING

When cleaning seawater strainer, close seacock, if so equipped. If boat is not equipped with a seacock, remove and plug seawater inlet hose to prevent a siphoning action that may occur, allowing seawater to flow from the drain holes or removed hoses.

⚠ CAUTION

Do not overtighten cover screws or cover will warp and leak.

2. With engine off, close seacock if so equipped or remove and plug seawater inlet hose, if no seacock exists. Remove 2 screws and washers, and cover. Remove strainer, and drain plug and washer. Clean any debris from strainer housing; flush both strainer and housing with clean water. Check gasket – replace when necessary (if it leaks). Reinstall drain plug and washer. Reattach cover with screws and washers. Open seacock, or unplug and reconnect seawater inlet hose. Tighten hose clamps securely. After starting engine, check for leaks, and/or air in system, which would indicate an external leak.



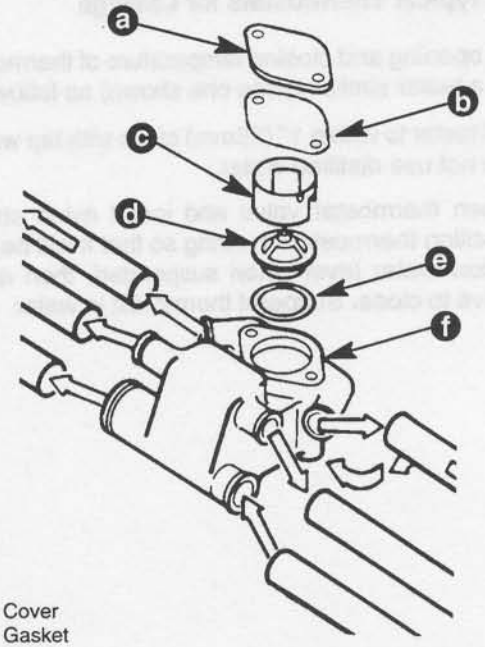
a - Screws and Washers
b - Cover, with Glass
c - Strainer
d - Housing
e - Drain Plug and Sealing Washer
f - Gasket

Quicksilver Seawater Strainer Shown

Thermostat

Removal

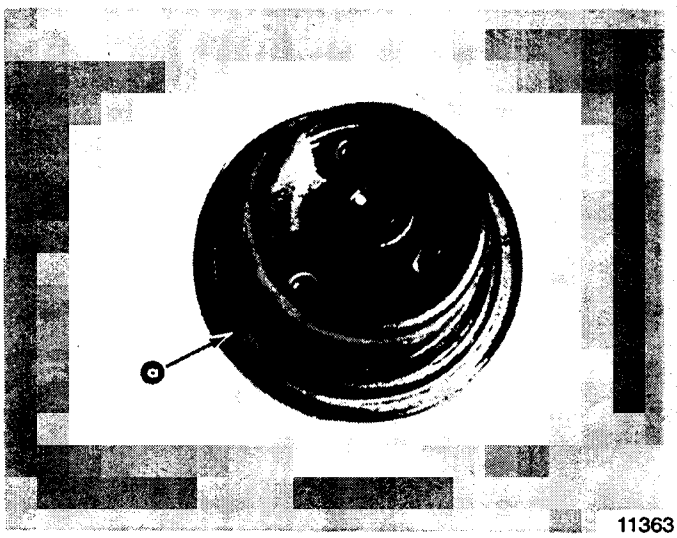
1. Drain water from cylinder block and exhaust manifolds.
2. Remove thermostat cover attaching bolts and lockwashers, then remove cover and gasket.
3. Remove thermostat from thermostat housing or cover.



a - Cover
b - Gasket
c - Spacer
d - Thermostat
e - O-Ring
f - Housing
g - Fasteners with Lockwashers

Testing

1. Clean thermostat in soap and water to remove any deposits or debris.
2. Inspect thermostat for corrosion or other visible damage.
3. If thermostat is suspected of producing insufficient engine temperature, check thermostat for leakage by holding it up to a lighted background. Light leakage around the thermostat valve indicates that thermostat is not closing completely and should be replaced. (A small amount of leakage at one or 2 points around the valve perimeter is acceptable.)



a - Check for Light Leakage Around Perimeter of Valve

Checking Typical Thermostats for Leakage

4. Check opening and closing temperature of thermostat (using a tester similar to the one shown) as follows:
   a. Fill tester to within 1″ (25mm) of top with tap water. Do not use distilled water.
   b. Open thermostat valve and insert nylon string. Position thermostat on string so that it will be just below water level when suspended, then allow valve to close. Suspend thermostat in water.
   c. Place thermometer in container and position so that bottom of thermometer is even with bottom of thermostat. Do not allow thermometer to touch container.

a - Thermometer
b - Nylon String
c - Thermostat

Thermostat Tester

IMPORTANT: When performing Steps d-thru-f, water must be agitated thoroughly to obtain accurate results.

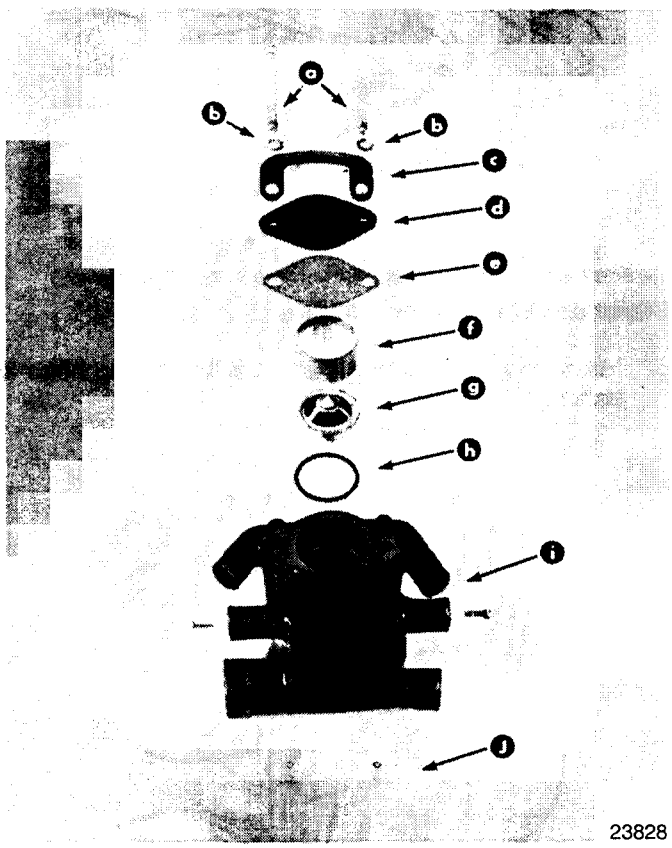
   d. Plug in tester and observe temperature at which thermostat opens (thermostat drops off thread). Thermostat must open at specified temperature stamped on thermostat.
   e. Continue to heat water until a temperature 25° F (14° C) above temperature specified on thermostat is obtained. Thermostat valve must be completely open at this temperature.
   f. Unplug tester and allow water to cool to a temperature 10° F (5° C) below specified temperature on thermostat. Thermostat must be completely closed at this temperature.
   g. Replace a thermostat that fails to meet all of the preceding tests.

Installation

1. Clean gasket surfaces on thermostat cover and thermostat housing.
2. If thermostat housing was disturbed during removal of thermostat, remove thermostat housing. Clean gasket surfaces on thermostat housing and intake manifold and replace thermostat housing-to-intake manifold gasket.

IMPORTANT: If gasket has continuity rivets, do not coat with Perfect Seal or audio warning temperature switch may not work properly.

3. Place O-ring in thermostat housing. Be certain it is positioned properly on mounting flange in housing.
4. Place thermostat in thermostat housing with thermostatic element end toward housing bottom.
5. Align tang on sleeve with groove in thermostat housing bore and install sleeve into housing.
6. Coat both sides of new thermostat cover-to-thermostat housing gasket with Perfect Seal and position on housing.
7. Reinstall thermostat cover (with Engine Lifting Eye, if so equipped) and torque screws with lockwashers to 30 lb. ft. (41 N·m).
8. Reconnect hose(s) to thermostat housing. Tighten hose clamps securely.
9. Start engine and inspect for leaks.



a - Screws
b - Lockwashers
c - Engine Lifting Eye
d - Cover
e - Upper Gasket
f - Sleeve
g - Thermostat
h - O-ring
i - Thermostat Housing
j - Thermostat Housing-to-Intake Manifold Gasket (with Continuity Rivets)

Cold Weather or Extended Storage (Draining)

Draining Precautions

⚠CAUTION

Seawater section of cooling system MUST BE COMPLETELY drained for extended storage, winter storage, or immediately after cold weather use, if the possibility of freezing temperatures exist. Failure to comply may result in trapped water causing freeze and/or corrosion damage to engine.

⚠CAUTION

If boat is in the water, seacock (water inlet valve), if so equipped, must be left closed until engine is to be restarted, to prevent water from flowing back into cooling system and/or boat. If boat is not fitted with a seacock, water inlet hose must be left disconnected and plugged, to prevent water from flowing back into cooling system and/or boat. As a precautionary measure, attach a tag to the ignition switch or steering wheel of the boat with the warning that the seacock must be opened or the water inlet hose reconnected prior to starting the engine.

IMPORTANT: Observe the following information to ensure complete draining of cooling system.

- **Engine must be as level as possible.**
- **A wire should be repeatedly inserted into all drain holes to ensure there are no obstructions in passages.**
- **On later models with two piece petcocks, removal of petcock may be required so that wire can be inserted completely into drain hole.**

IMPORTANT: To prevent threads in manifolds, elbows and cylinder blocks from rusting out during storage, reinstall plugs using Perfect Seal on threads. Never leave drain plugs out during storage.

NOTE: If possible, place a container under drains and hoses to prevent water from draining into boat.

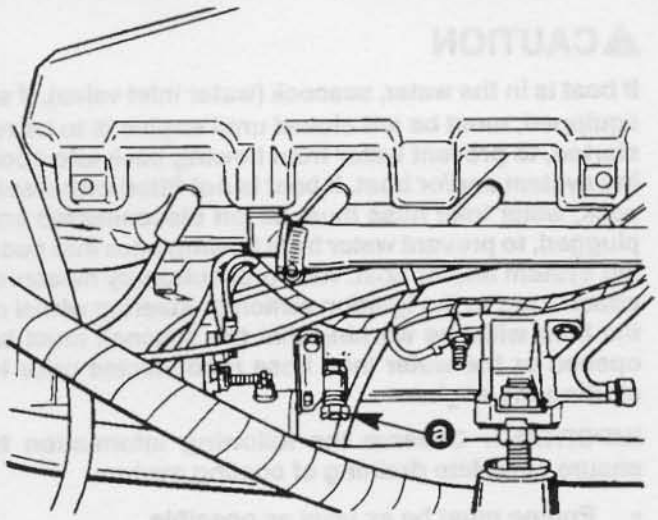
MCM (Stern Drive) Models

MCM 305/350/454/502 CID ENGINES

NOTICE

Refer to "Draining Precautions," in this section, BEFORE proceeding.

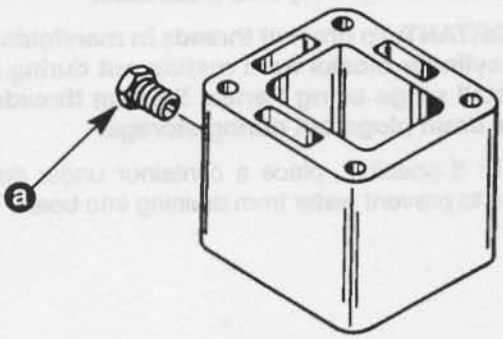
1. Engine must be as level as possible to ensure complete draining of cooling system.
2. Remove petcocks or plugs (port and starboard) from cylinder block.



a - Petcock (or Plug)

Starboard Side Shown (Port Similar)

3. If equipped with 3 in. or 6 in. (76mm or 152mm) risers, remove drain plug as shown from port and starboard risers.



a - Drain Plug (Remove)

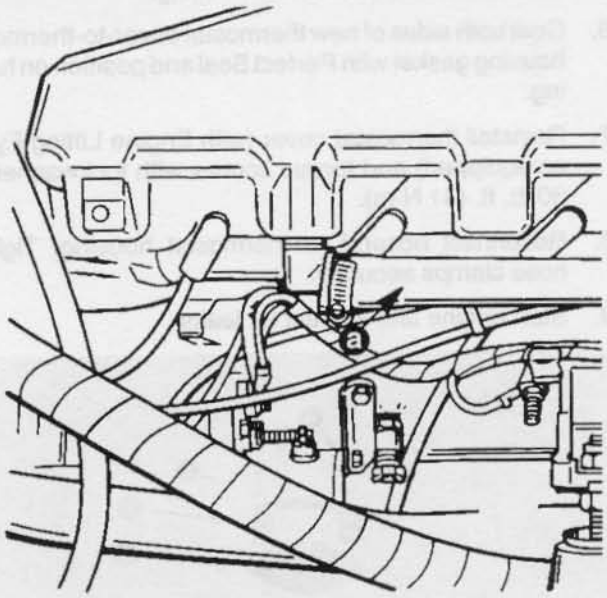
Typical Riser Shown (if Equipped)

4. Repeatedly clean out drain holes using a stiff piece of wire. Do this until entire system is drained.

NOTE: It may be necessary to lift, bend, or lower hoses to allow water to drain completely when hoses are disconnected.

5. Remove hose from bottom of port and starboard manifolds.

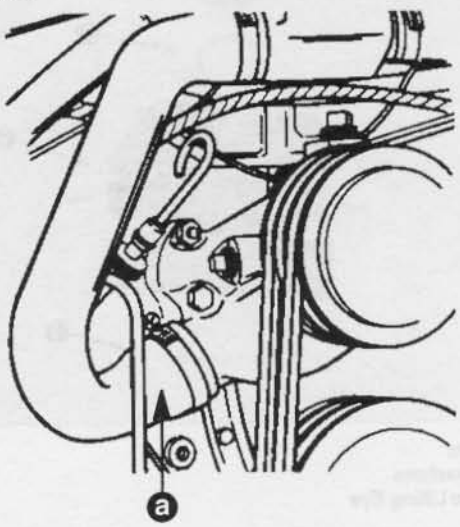
NOTE: Some exhaust manifolds are equipped with draincock(s) or plug(s) on the end(s). With the engine level, sufficient draining of manifolds will occur when exhaust manifold-to-thermostat housing hoses are removed.



a - Bottom Hose, Exhaust Manifold-to-Thermostat Housing

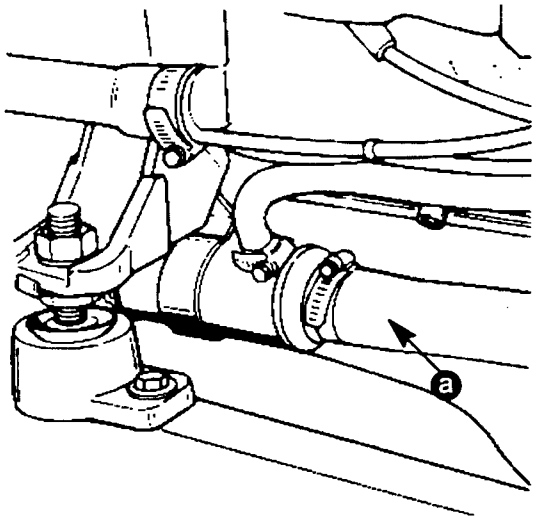
Starboard Shown (Port Similar)

6. Remove the engine water circulating pump hose as shown.



a - Hose, Water Circulating Pump-to-Thermostat Housing

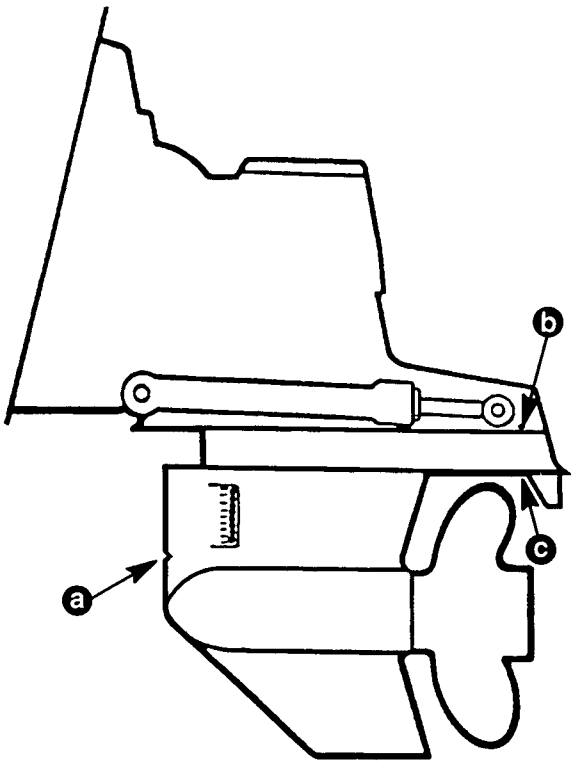
7. Remove the oil/power steering fluid cooler hose, as shown.



a - Hose, Seawater Pump-to-Cooler

8. Follow instructions "a" or "b":

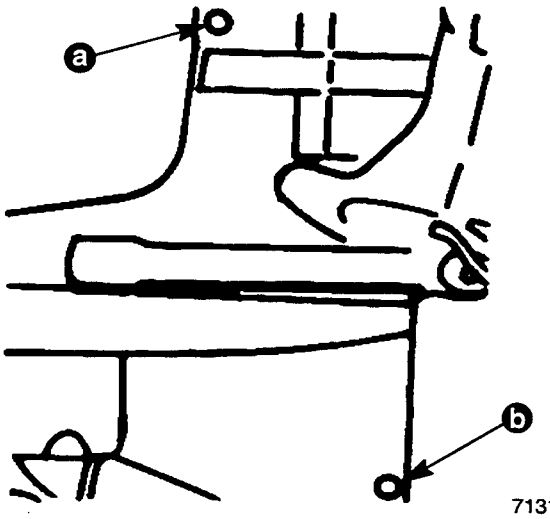
   a. **On Bravo Drive Equipped Models:** Insert a small wire (repeatedly) to make sure that speedometer pitot tube, trim tab cavity vent hole, and trim tab cavity drain passage are unobstructed and open.



a - Speedometer Pitot Tube
b - Trim Tab Cavity Vent Hole
c - Trim Tab Cavity Drain Passage

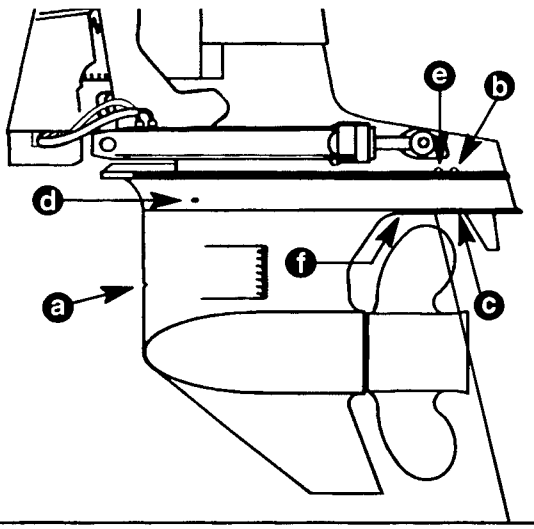
Bravo Drive Unit

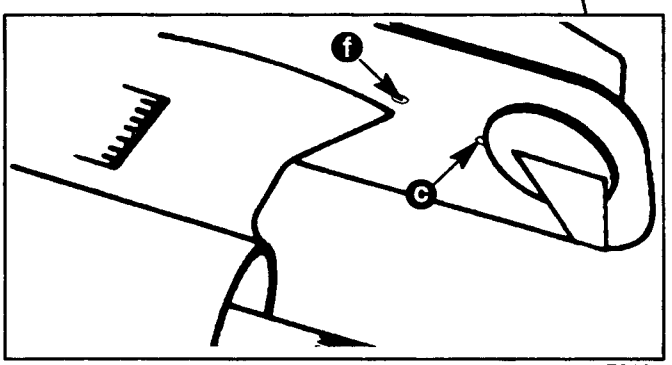
   b. **On Alpha Drive Equipped Models:** Insert a small wire (repeatedly) to make sure that vent holes and water drain holes and passages (as shown) are unobstructed and open.



a - Drive Shaft Housing Water Drain Hole
b - Gear Housing Water Drain Hole

Alpha One Drive Unit

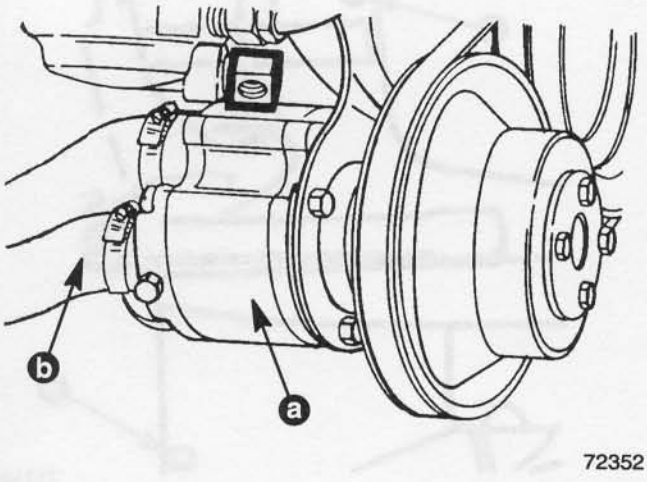




a - Speedometer Pitot Tube
b - Trim Tab Cavity Vent Hole
c - Trim Tab Cavity Drain Passage
d - Gear Housing Water Drain Hole (One Each - Port and Starboard)
e - Gear Housing Cavity Vent Hole
f - Gear Housing Cavity Drain Hole

Alpha One Generation II Drive Unit

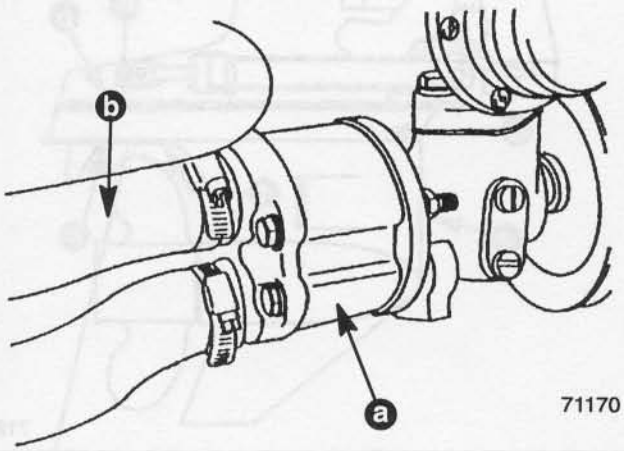
9. Remove seawater inlet hose as shown.



72352

Seawater Pump Without Combination Fuel Pump

a - Seawater Pickup Pump
b - Seawater Pump Inlet Hose

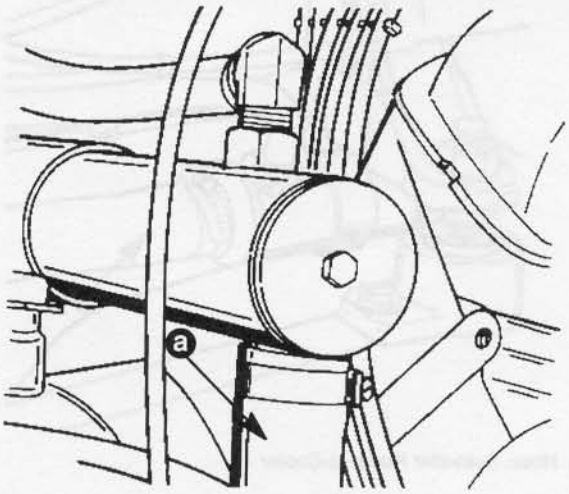


71170

Seawater Pump With Combination Fuel Pump

a - Seawater Pickup Pump
b - Seawater Pump Inlet Hose

10. Follow instructions "a" or "b":
    a. **On All Engines Except 502:** Proceed to step 11.
    b. **On 502 Engines:** Remove the oil/power steering fluid cooler seawater hose, as shown.



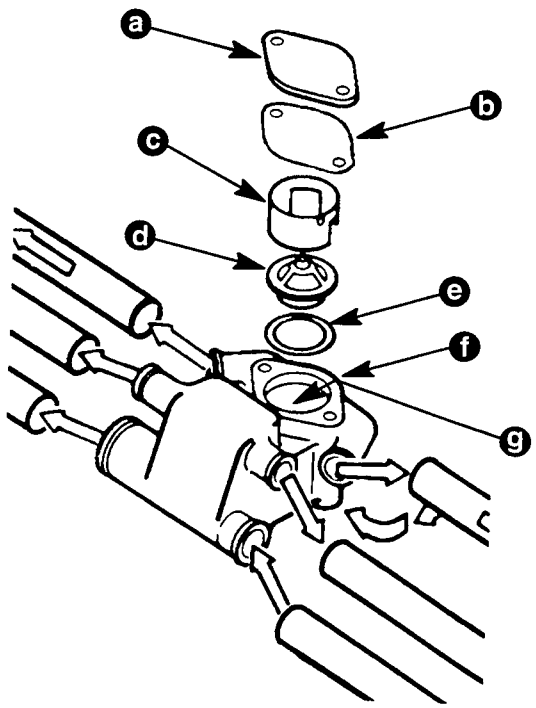
a - Hose, Seawater Pump-to-Cooler

11. Crank engine over SLIGHTLY, with starter motor, to purge any water trapped in seawater pickup pump. DO NOT ALLOW ENGINE TO START.

12. After cooling system has been drained completely, install and tighten securely all petcocks or drain plugs. Reconnect all hoses and tighten all hose clamps securely.

IMPORTANT: MerCruiser recommends that propylene glycol antifreeze (nontoxic and biodegradable, which makes it friendly to lakes and rivers) be used in seawater section of the cooling system for cold weather or extended storage. Make sure that the propylene glycol antifreeze contains a rust inhibitor and is recommended for use in marine engines. Be certain to follow the propylene glycol manufacturer's recommendations.

13. For additional assurance against freezing and rust, remove the thermostat cover and thermostat. Fill the engine seawater cooling system with a mixture of antifreeze and tap water mixed to manufacturer's recommendation to protect engine to the lowest temperature to which it will be exposed during cold weather or extended storage. Using a new gasket, reinstall thermostat and cover. Tighten cover bolts securely.



a - Cover
b - Gasket
c - Spacer
d - Thermostat
e - O-ring
f - Housing
g - Fill Here

NOTE: Hoses shown removed only to indicate flow. Do not remove hoses.

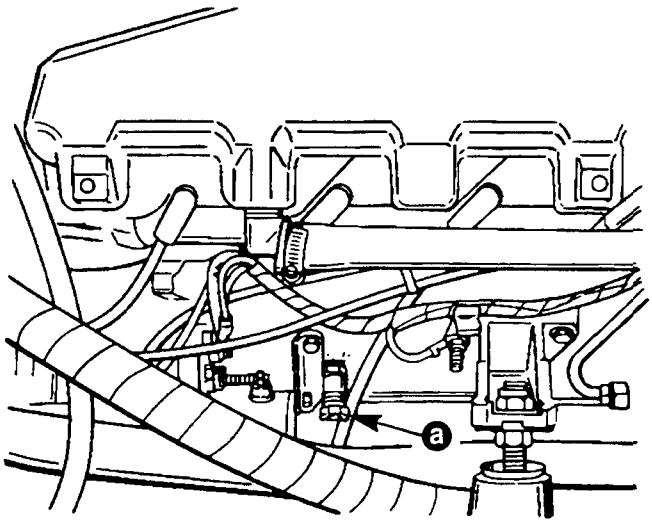
MIE (Inboard) Models

MIE 305/350 CID ENGINES

NOTICE

Refer to "Draining Precautions," in this section, BEFORE proceeding.

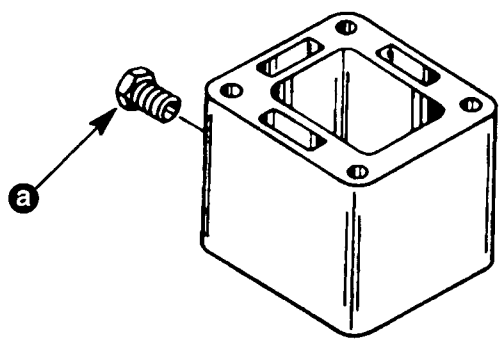
1. Engine must be as level as possible to ensure complete draining of cooling system.
2. Remove petcocks or plugs (port and starboard) from cylinder block.



a - Petcock (or Plug)

Starboard Side Shown (Port Similar)

3. If equipped with 3 in. or 6 in. (76mm or 152mm) risers, remove drain plug as shown from port and starboard risers.



a - Drain Plug (Remove)

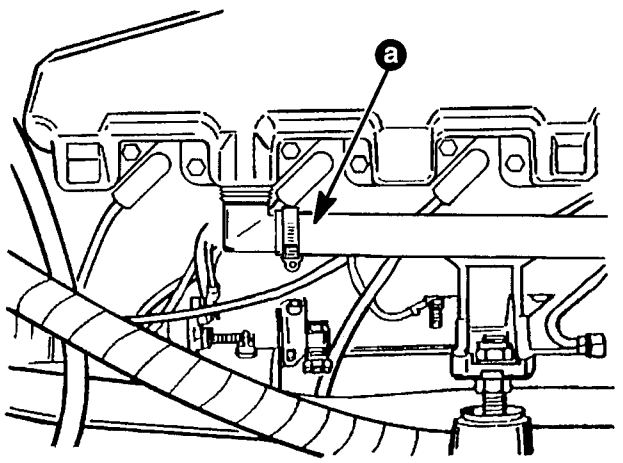
Typical Riser Shown (if Equipped)

4. Repeatedly clean out drain holes using a stiff piece of wire. Do this until entire system is drained.

NOTE: *It may be necessary to lift, bend, or lower hoses to allow water to drain completely when hoses are disconnected.*

5. Remove hose from bottom of port and starboard manifolds.

NOTE: *Some exhaust manifolds are equipped with drain cock(s) or plug(s) on the end(s). With the engine level, sufficient draining of manifolds will occur when exhaust manifold to thermostat housing hoses are removed.*

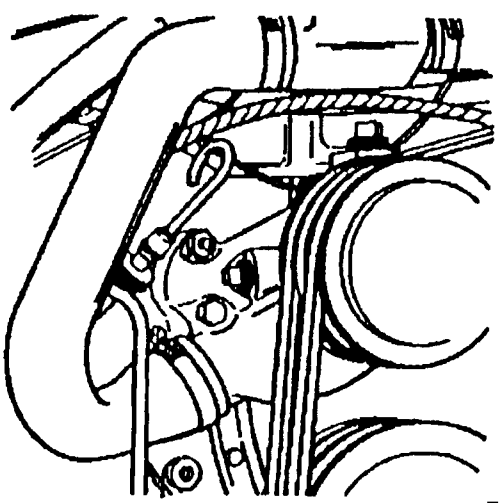


72609

Starboard Side Shown

a - Bottom Hose, Exhaust Manifold-To-Thermostat Housing

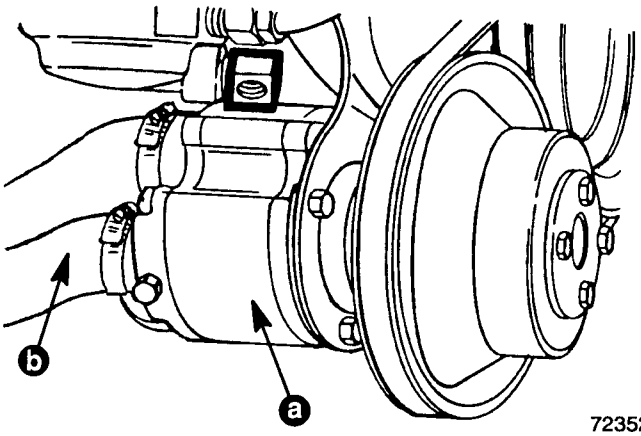
6. Remove the engine water circulating pump hose as shown.



72587

a - Hose Water Circulating Pump-To-Thermostat Hosuing

7. Remove seawater inlet hose as shown.

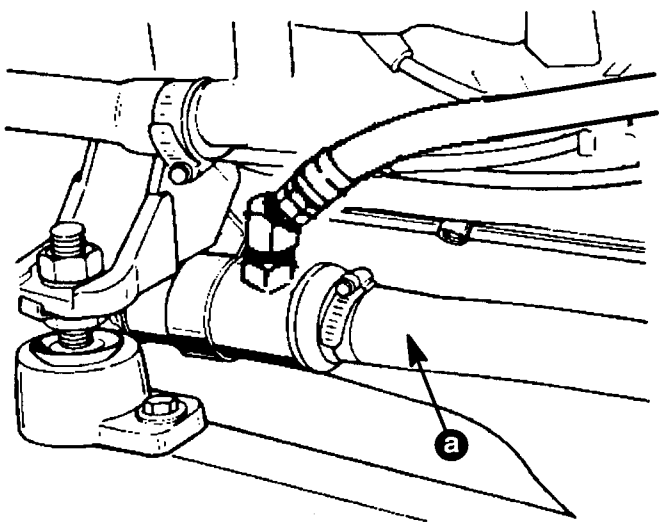


72352

Seawater Pump Without Combination Fuel Pump

a - Seawater Pickup Pump
b - Seawater Pump Inlet Hose

8. Remove the transmission fluid cooler hose, as shown.



71782

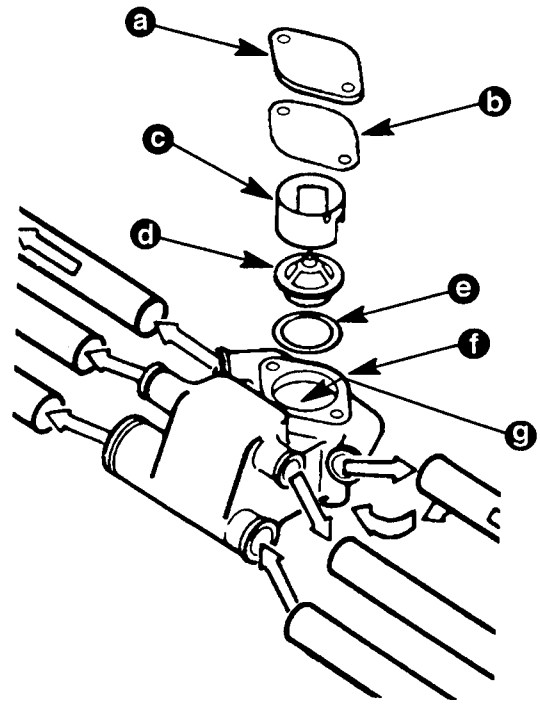
a - Hose, Seawater Pickup Pump-To-Cooler

9. Crank engine over SLIGHTLY, with starter motor, to purge any water trapped in seawater pickup pump. DO NOT ALLOW ENGINE TO START.

10. After cooling system has been drained completely, install and tighten securely all petcocks or drain plugs. Reconnect all hoses and tighten all hose clamps securely.

IMPORTANT: MerCruiser recommends that propylene glycol antifreeze (nontoxic and biodegradable, which makes it friendly to lakes and rivers) be used in seawater section of the cooling system for cold weather or extended storage. Make sure that the propylene glycol antifreeze contains a rust inhibitor and is recommended for use in marine engines. Be certain to follow the propylene glycol manufacturer's recommendations.

11. For additional assurance against freezing and rust, remove the thermostat cover and thermostat. Fill the engine seawater cooling system with a mixture of antifreeze and tap water mixed to manufacturer's recommendation to protect engine to the lowest temperature to which it will be exposed during cold weather or extended storage. Using a new gasket, reinstall thermostat and cover. Tighten cover bolts securely.



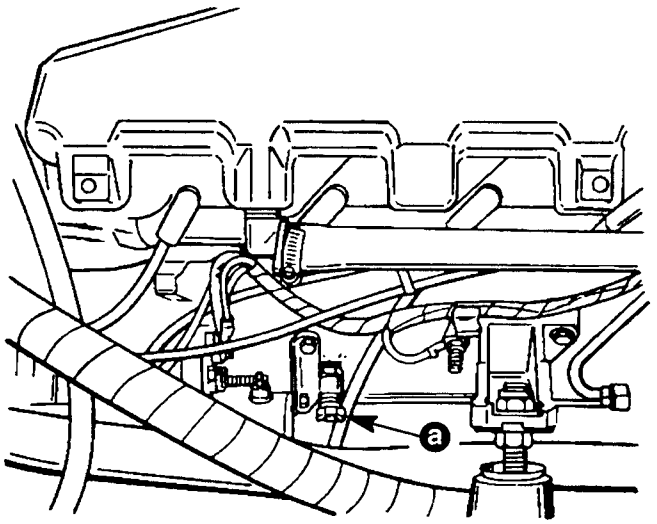
a - Cover
b - Gasket
c - Spacer
d - Thermostat
e - O-ring
f - Housing
g - Fill Here

NOTE: Hoses shown removed only to indicate flow. Do not remove hoses.

NOTICE

Refer to "Draining Precautions," in this section, BEFORE proceeding.

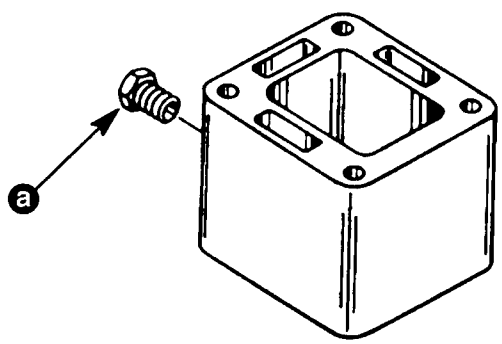
1. Engine must be as level as possible to ensure complete draining of cooling system.
2. Remove petcocks or plugs (port and starboard) from cylinder block.



a - Petcock (or Plug)

Starboard Side Shown (Port Similar)

3. If equipped with 3 in. or 6 in. (76mm or 152mm) risers, remove drain plug as shown from port and starboard risers.



a - Drain Plug (Remove)

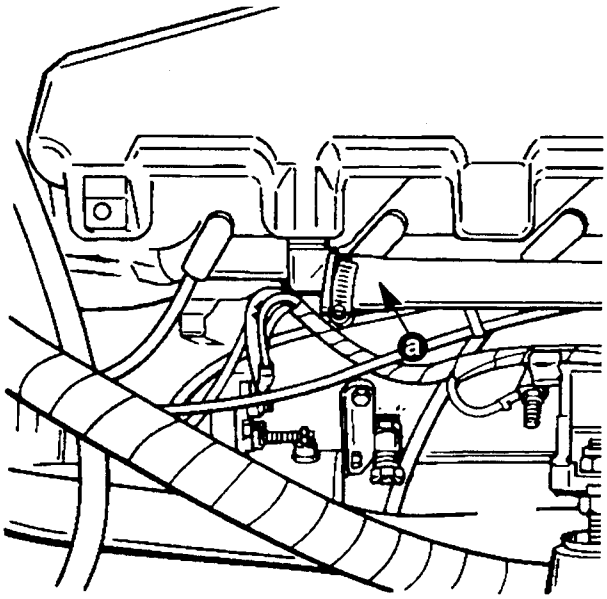
Typical Riser Shown (If Equipped)

4. Repeatedly clean out drain holes using a stiff piece of wire. Do this until entire system is drained.

NOTE: It may be necessary to lift, bend, or lower hoses to allow water to drain completely when hoses are disconnected.

5. Remove hose from bottom of port and starboard manifolds.

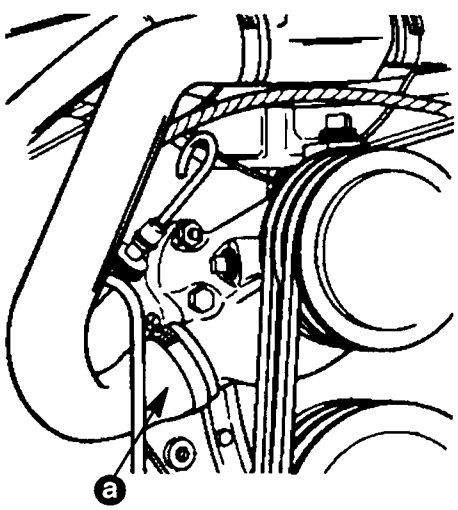
NOTE: Some exhaust manifolds are equipped with draincock(s) or plug(s) on the end(s). With the engine level, sufficient draining of manifolds will occur when exhaust manifold-to-thermostat housing hoses are removed.



a - Hose, Exhaust Manifold-to-Thermostat Housing

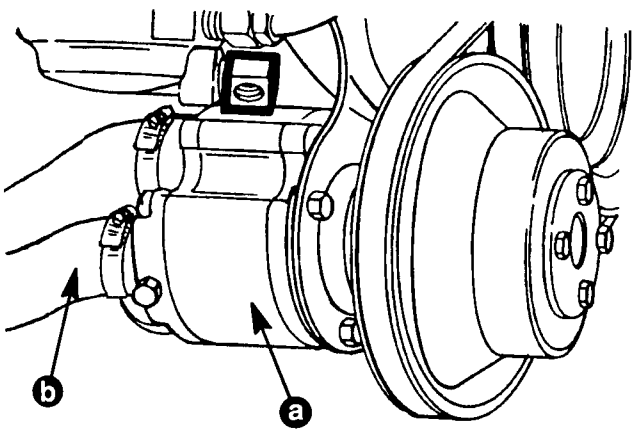
Starboard Shown (Port Similar)

6. Remove the engine water circulating pump hose as shown.



a - Hose, Water Circulating Pump-to-Thermostat Housing

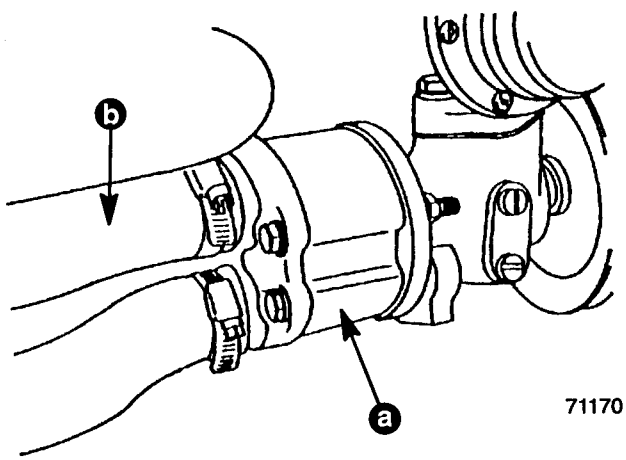
7. Remove seawater inlet hose as shown.



72352

Seawater Pump Without Combination Fuel Pump

a - Seawater Pickup Pump
b - Seawater Pump Inlet Hose

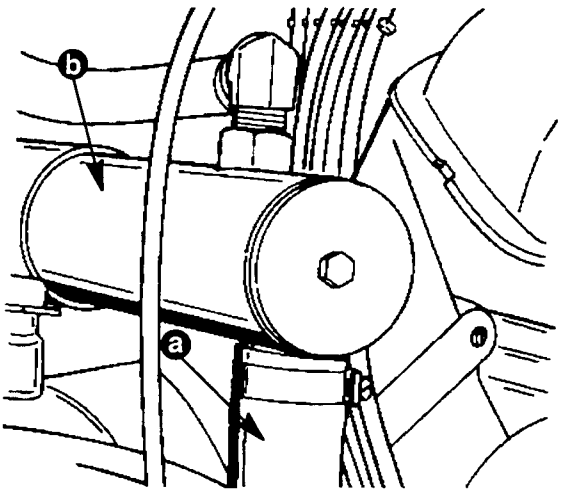


71170

Seawater Pump With Combination Fuel Pump

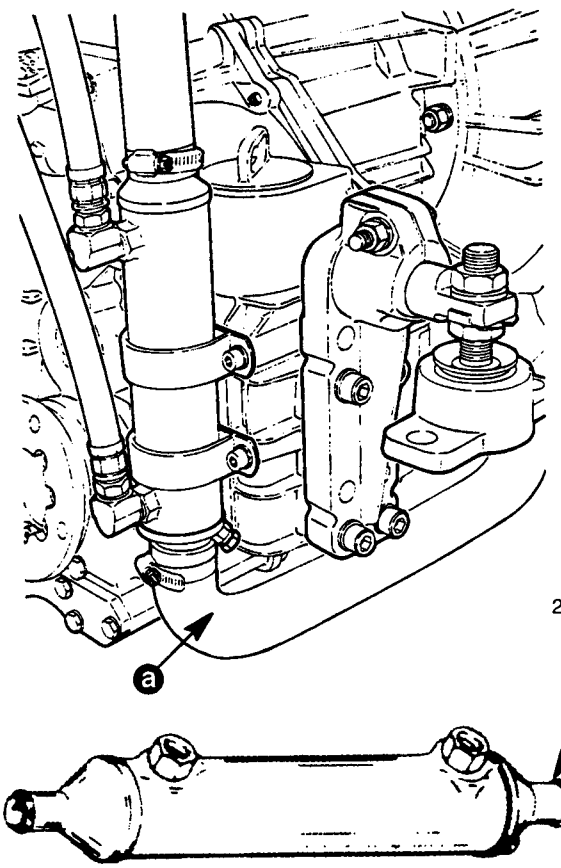
a - Seawater Pickup Pump
b - Seawater Pump Inlet Hose

8. Remove the engine oil cooler seawater hose, as shown.



a - Hose, Seawater
b - Engine Oil Cooler

9. Remove the transmission oil cooler seawater hose, as shown.



27665

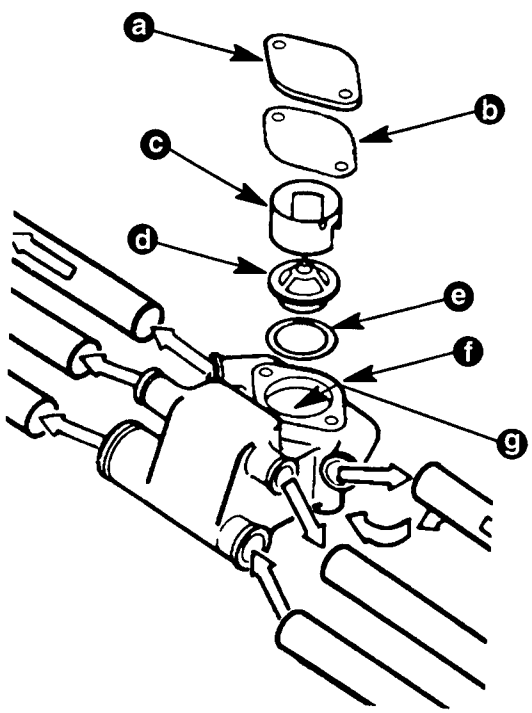
a - Hose, Seawater Pump-to-Transmission Cooler (Hurth Transmissions)
b - Hose Location, Seawater Pump-to-Transmission Cooler (Borg-Warner Transmissions) (Hose Not Shown)

10. Crank engine over SLIGHTLY, with starter motor, to purge any water trapped in seawater pickup pump. DO NOT ALLOW ENGINE TO START.

11. After cooling system has been drained completely, install and tighten securely all petcocks or drain plugs. Reconnect all hoses and tighten all hose clamps securely.

IMPORTANT: MerCruiser recommends that propylene glycol antifreeze (nontoxic and biodegradable, which makes it friendly to lakes and rivers) be used in seawater section of the cooling system for cold weather or extended storage. Make sure that the propylene glycol antifreeze contains a rust inhibitor and is recommended for use in marine engines. Be certain to follow the propylene glycol manufacturer's recommendations.

12. For additional assurance against freezing and rust, remove the thermostat cover and thermostat. Fill the engine seawater cooling system with a mixture of antifreeze and tap water mixed to manufacturer's recommendation to protect engine to the lowest temperature to which it will be exposed during cold weather or extended storage. Using a new gasket, reinstall thermostat and cover. Tighten cover bolts securely.



a - Cover
b - Gasket
c - Spacer
d - Thermostat
e - O-ring
f - Housing
g - Fill Here

NOTE: Hoses shown removed only to indicate flow. Do not remove hoses.

Auxiliary Hot Water Heater Installation

IMPORTANT: When connecting a cabin heater or hot water heater, certain requirements must be met.

- **Supply hose (from engine to heater) and return hose (from heater to engine) MUST NOT EXCEED 5/8 inch (15.8mm) I.D. (inside diameter).**
- **Engine equipped with a closed cooling system: Heater MUST BE LOWER than fill cap on the heat exchanger. If the heater is higher than the fill cap on the heat exchanger and some coolant is lost in the system, an air pocket may form in the closed cooling system. This, in turn, can cause the engine to overheat.**
- **Make heater connections ONLY at locations described in the following instructions.**
- **Check complete system for leaks after heater is connected into cooling system.**
- **Check for overheating condition (of engine) after heater is connected.**

1. Refer to Changing Coolant – "Draining Precautions" and "Draining Instructions," and drain closed cooling system.

NOTE: Hot water heater supply hose can be connected at several different locations. On some models, there may be other accessories and options that are utilizing these hot water supply locations. One of the following should be available for use when installing a hot water heater system.

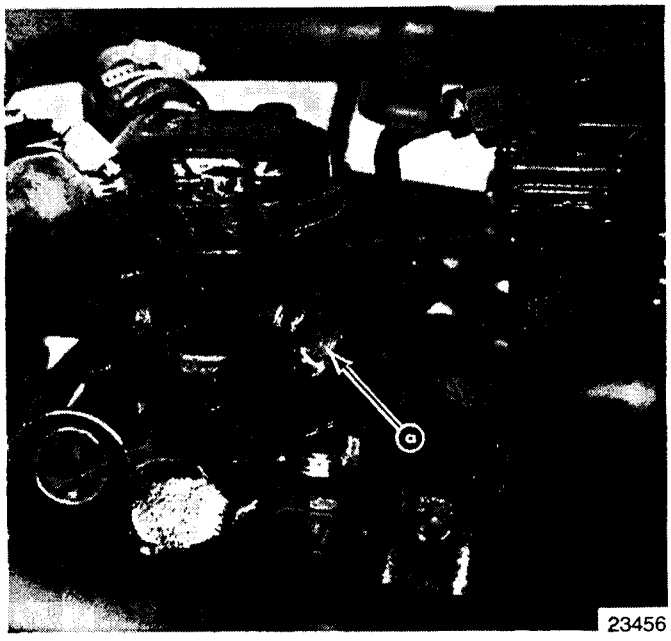
a. Port side of thermostat housing.

NOTE: On some models it may be necessary to remove the Audio Warning Heat Switch from port side of thermostat housing and reposition to water circulating pump opening as outlined following.

b. Starboard side of thermostat housing, unless being utilized for engine temperature switch.

IMPORTANT: Do not reposition engine temperature switch, it must remain where installed by factory.

c. Intake manifold near thermostat housing (some models).



Thermostat Housing - Port Side Shown (Starboard Similar)

Intake Manifold - (If Engine Temperature Sender is Not Installed at This Location) (Except 1988 and Newer 350 Magnum)

2. Connect hot water heater SUPPLY hose to desired location following instructions "a" or "b":

   a. **On Models with Pipe Plug, in Thermostat Housing (port or starboard) or Intake Manifold:**

      (1) Remove pipe plug.

      (2) Coat threads of fitting(s) (obtained locally) with Perfect Seal and install fitting(s) in threaded hold from which pipe plug was removed.

      (3) Connect hot water heat supply hose to fitting and secure with a hose clamp (not provided).

   b. **On Models with Audio Warning Heat Switch in Thermostat Housing (Port Side):**

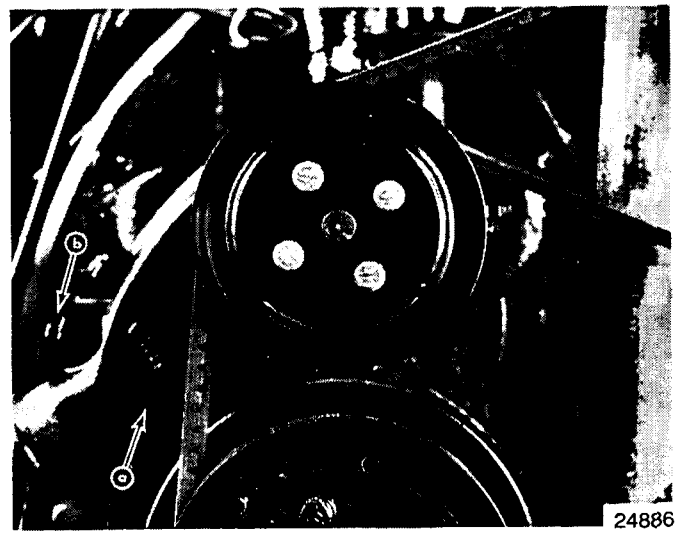
      (1) Disconnect Tan/Blue wire from audio warning switch.

      (2) Remove audio warning switch from thermostat housing.

      (3) Coat threads of fitting(s) (obtained locally) with Perfect Seal and install fitting(s) in threaded hole from which pipe plug was removed.

      (4) Connect hot water heater supply hose to fitting and secure with a hose clamp (not provided).

      (5) Remove pipe plug from starboard side of engine water circulating pump.



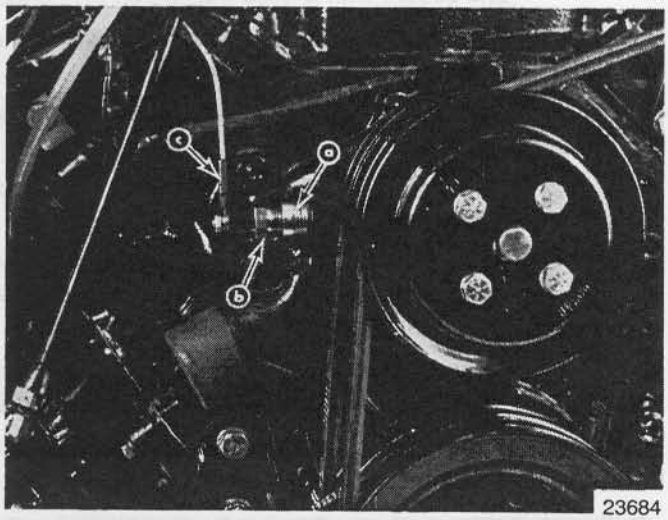
a - Engine Water Circulating Pump
b - Pipe Plug

(6) Apply Loctite Pipe Sealant (with teflon) to threads of reducer bushing (obtain locally) and audio warning heat switch.

(7) Install reducer bushing in circulating pump and tighten securely.

(8) Install audio warning switch in reducer bushing and tighten securely.

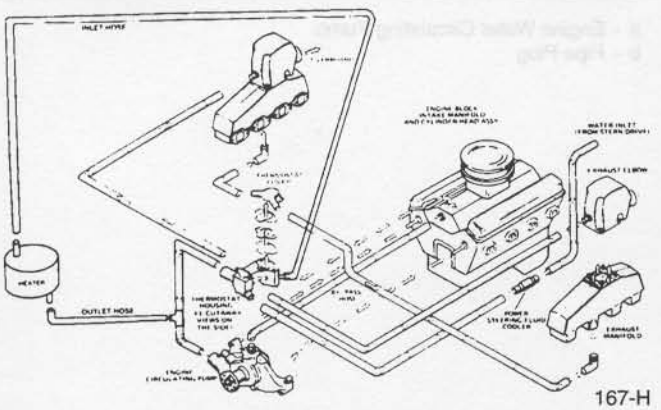
(9) Connect Tan/Blue wire to switch and secure with nut and lockwasher. Coat terminal with Liquid Neoprene.



23684

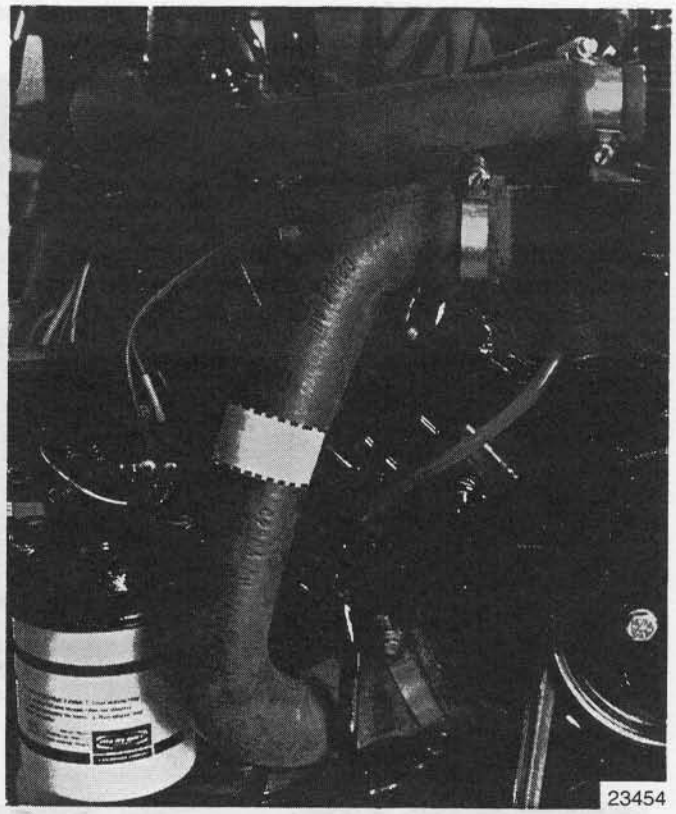
a - Reducer Bushing
b - Audio Warning Heat Switch
c - Tan/Blue Wire

3. Connect hot water heater return hose into system as follows (refer to figures):
   a. Cut approximately 3/4 inch (19mm) out of hose to maintain proper hose configuration.
   b. Secure "T" fitting in hose with hose clamps (provided in kit) and tighten securely.
   c. Connect hot water heat return hose to "T" fitting and secure with hose clamp (provided).
4. Secure hoses, as required, to ensure they do not rub or chafe against engine components.
5. With boat in water, start engine and check for leaks and overheating.



167-H

Heater Connection on Typical MerCruiser V-8 Engine with Standard Cooling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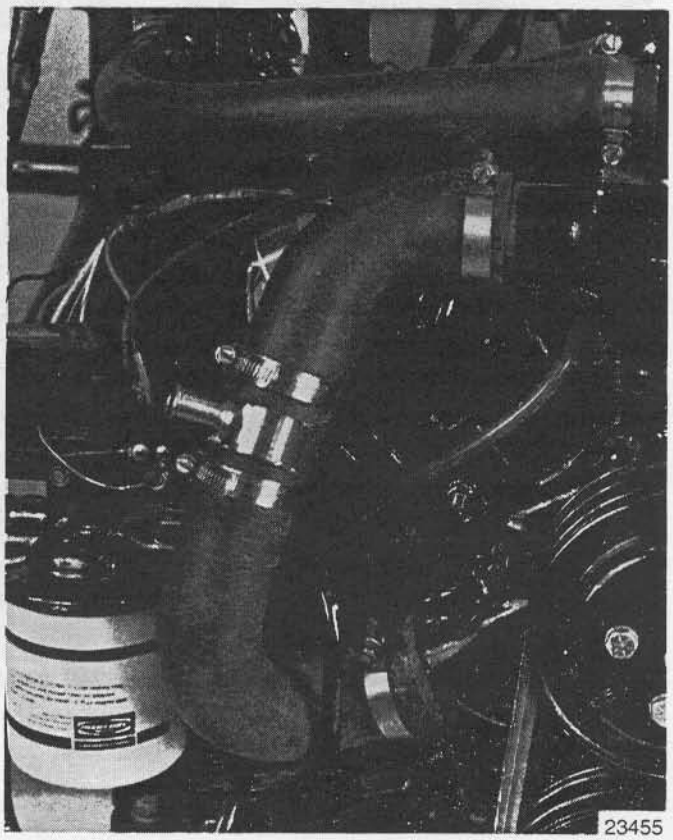
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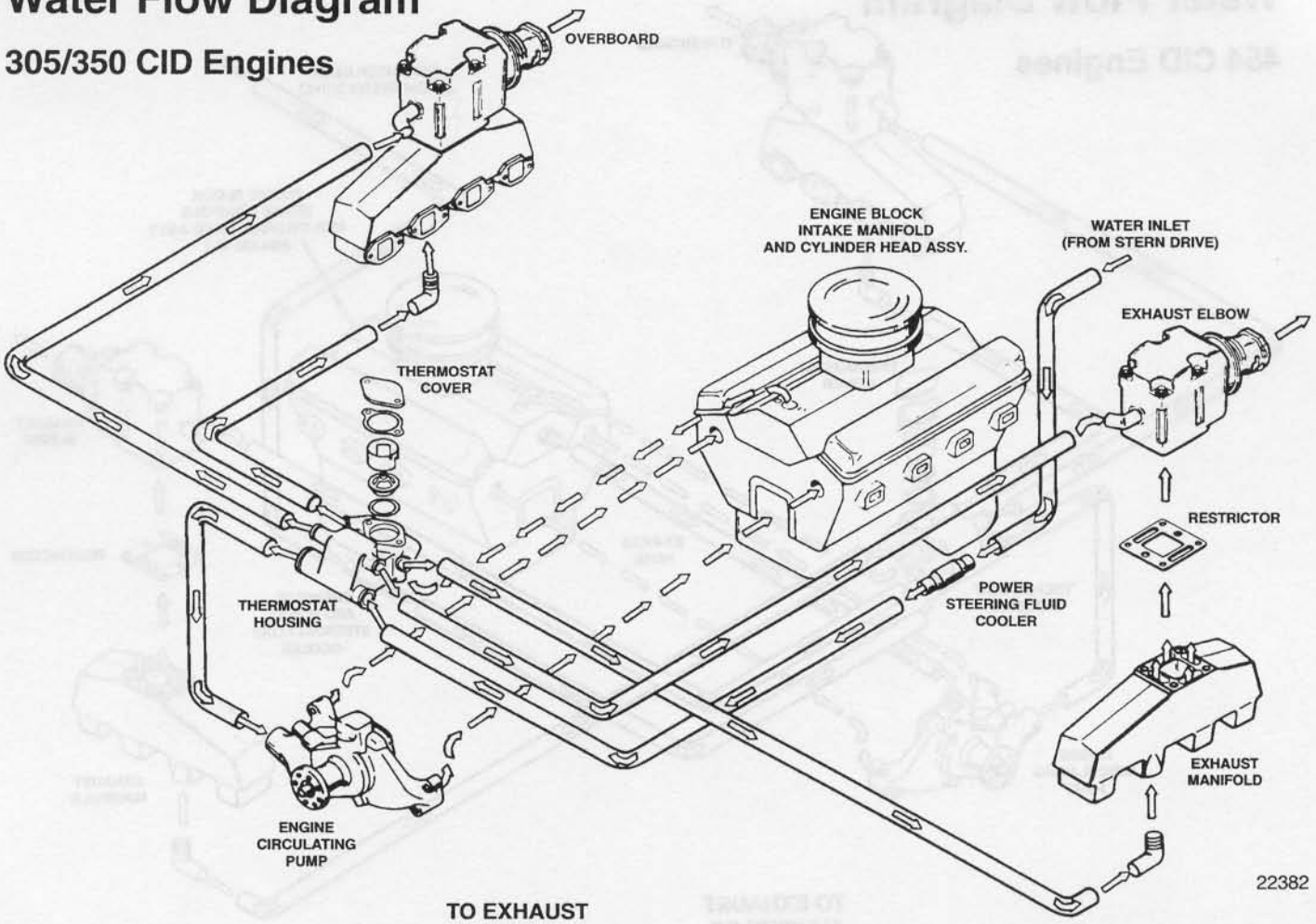
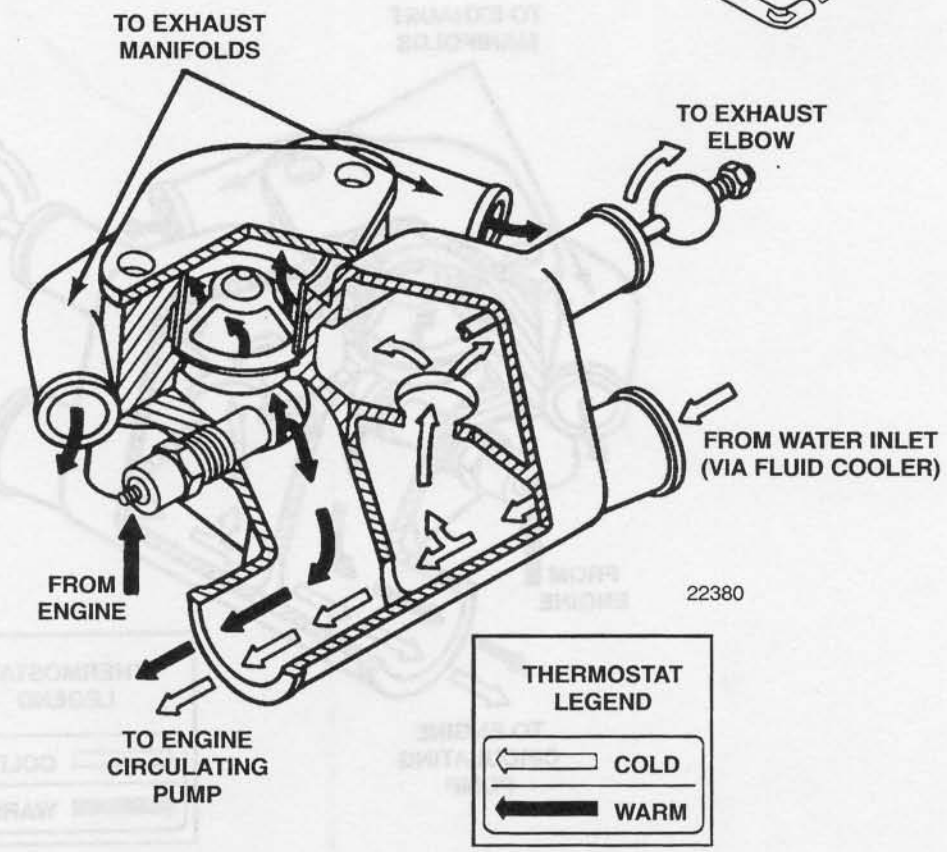
Water Flow Diagram

305/350 CID Engines

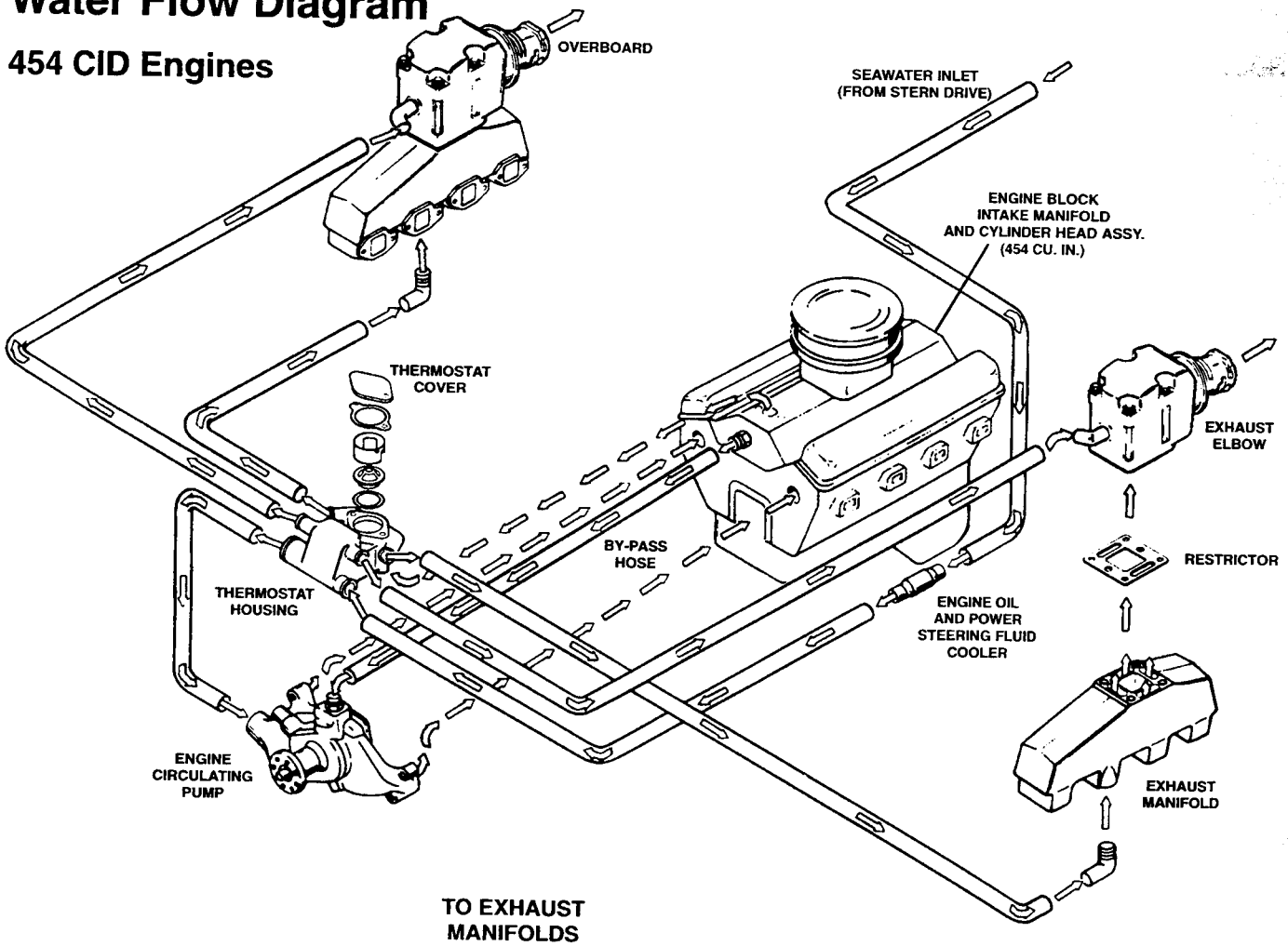


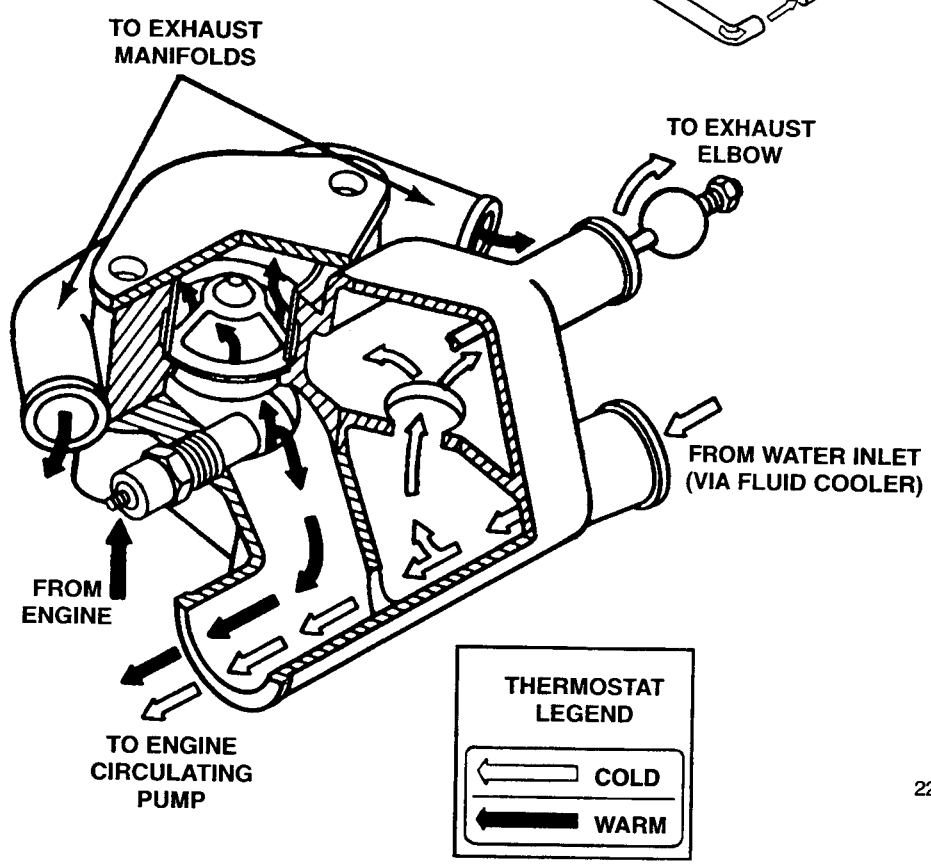


MCM - 5.0 Litre, 5.0 Litre LX, 5.7 Litre, 350 Magnum

Water Flow Diagram

454 CID Engines





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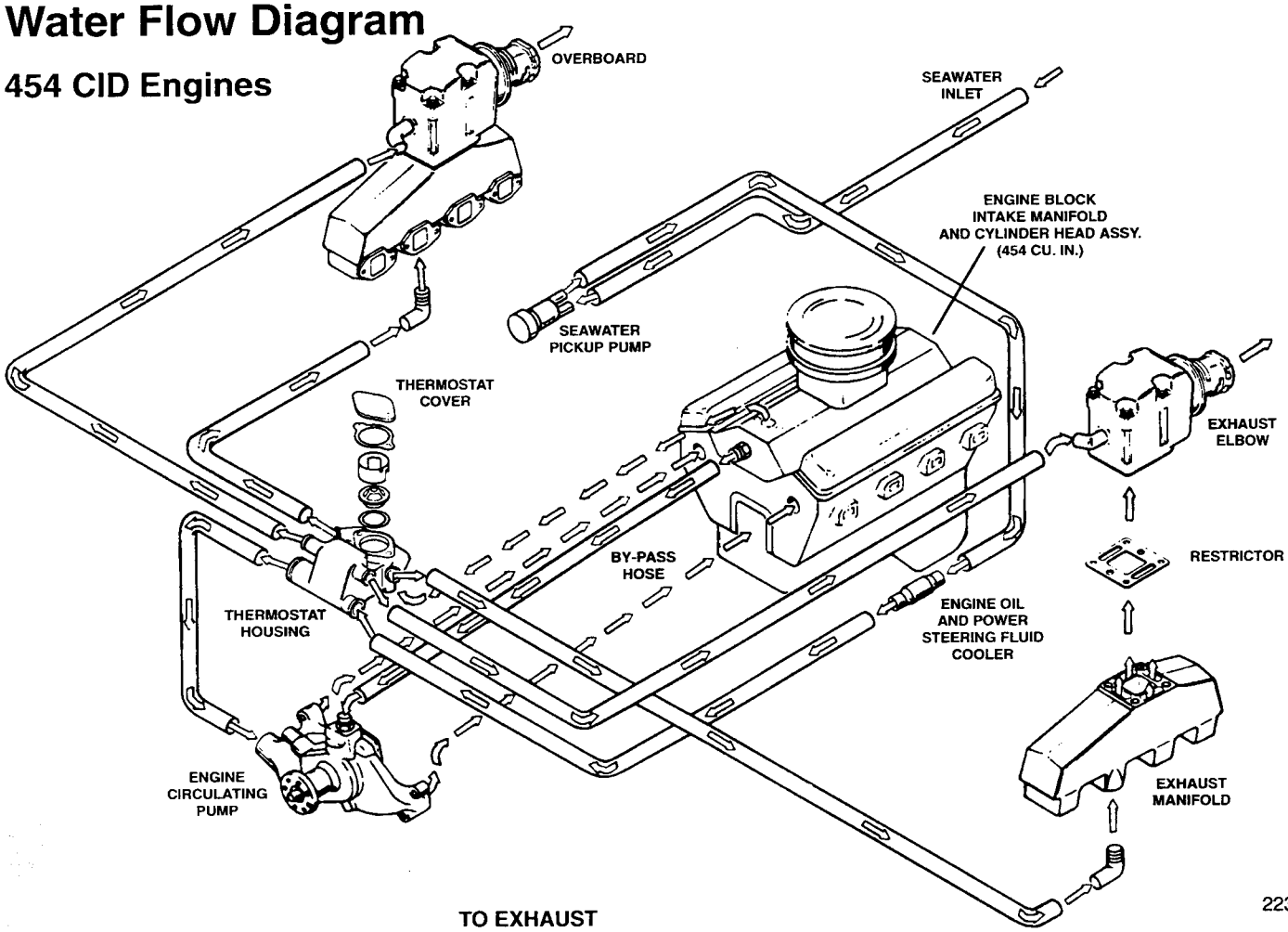
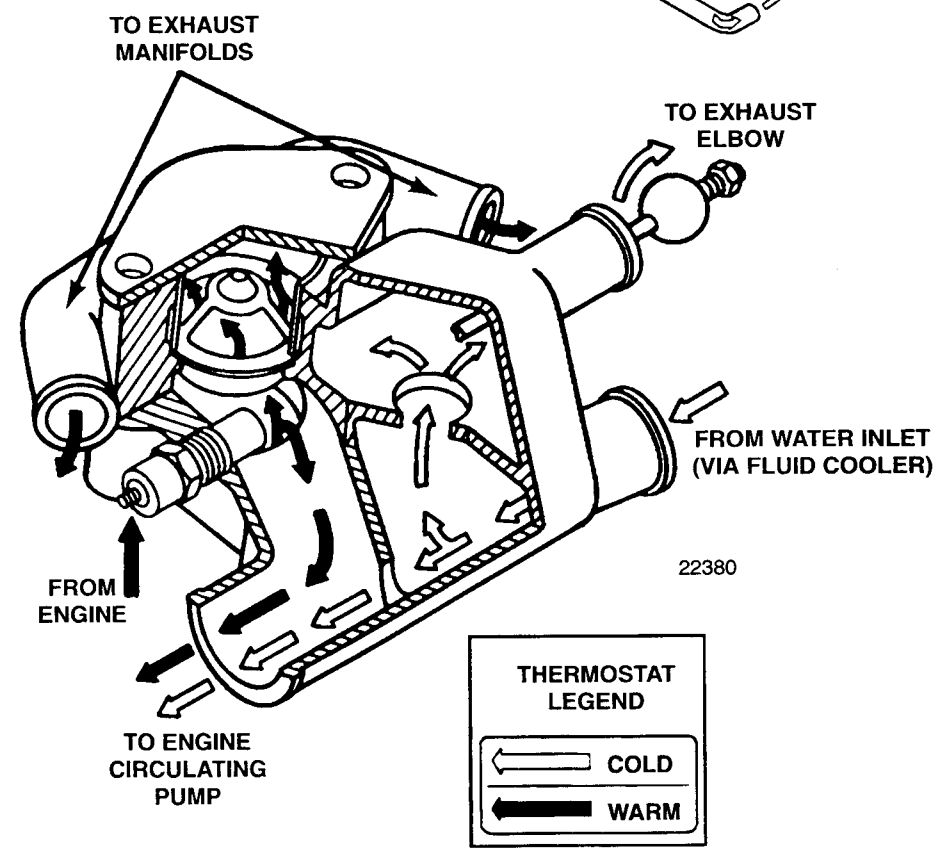
Water Flow Diagram

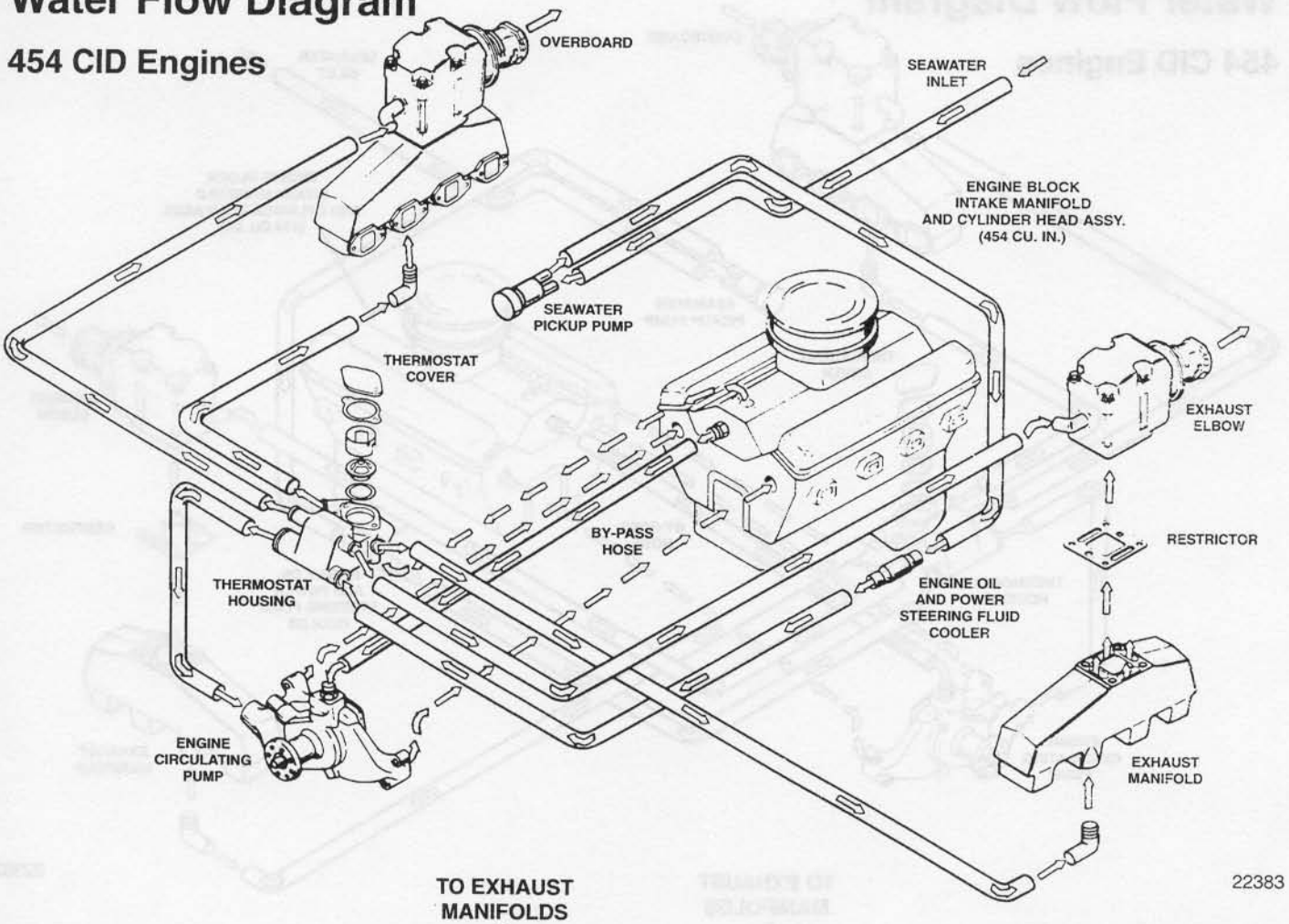
454 CID Engines

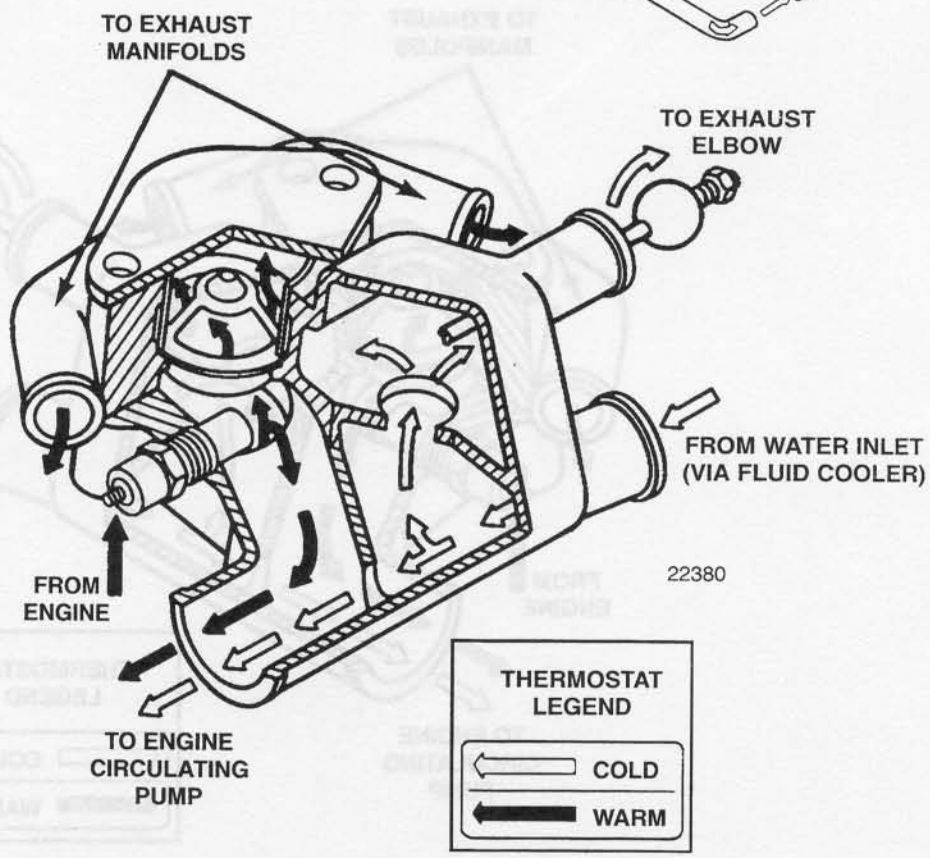




Water Flow Diagram

454 CID Engines

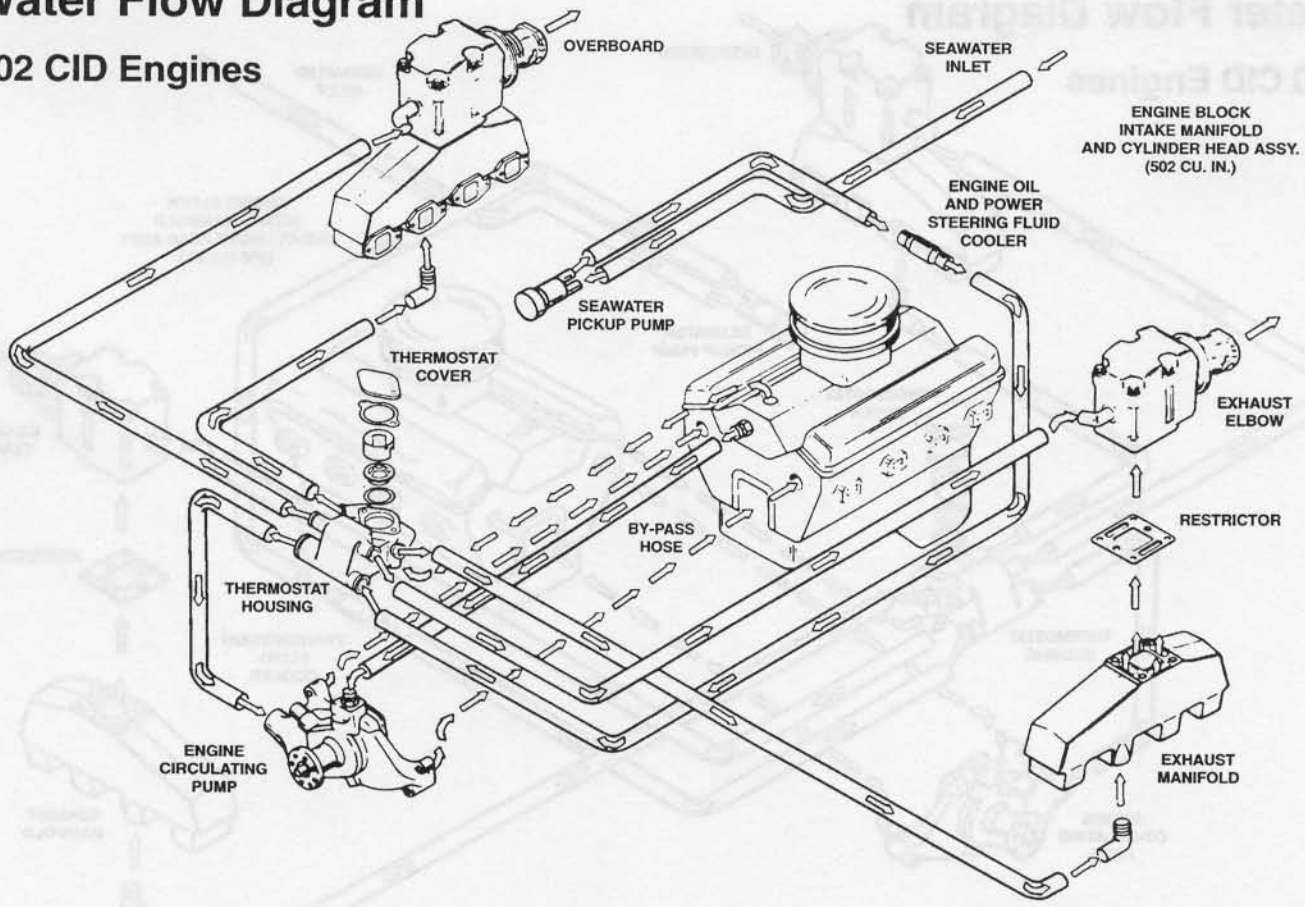




MCM - 7.4 Litre (Bravo One and Bravo Two)

Water Flow Diagram

502 CID Engines



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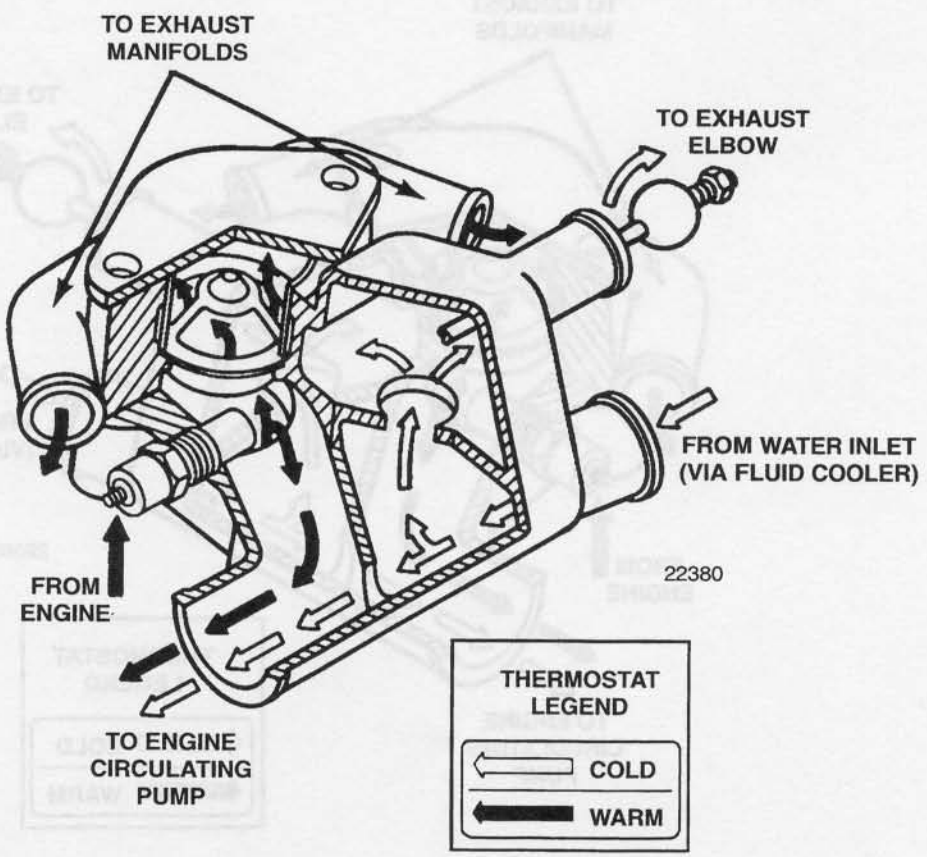

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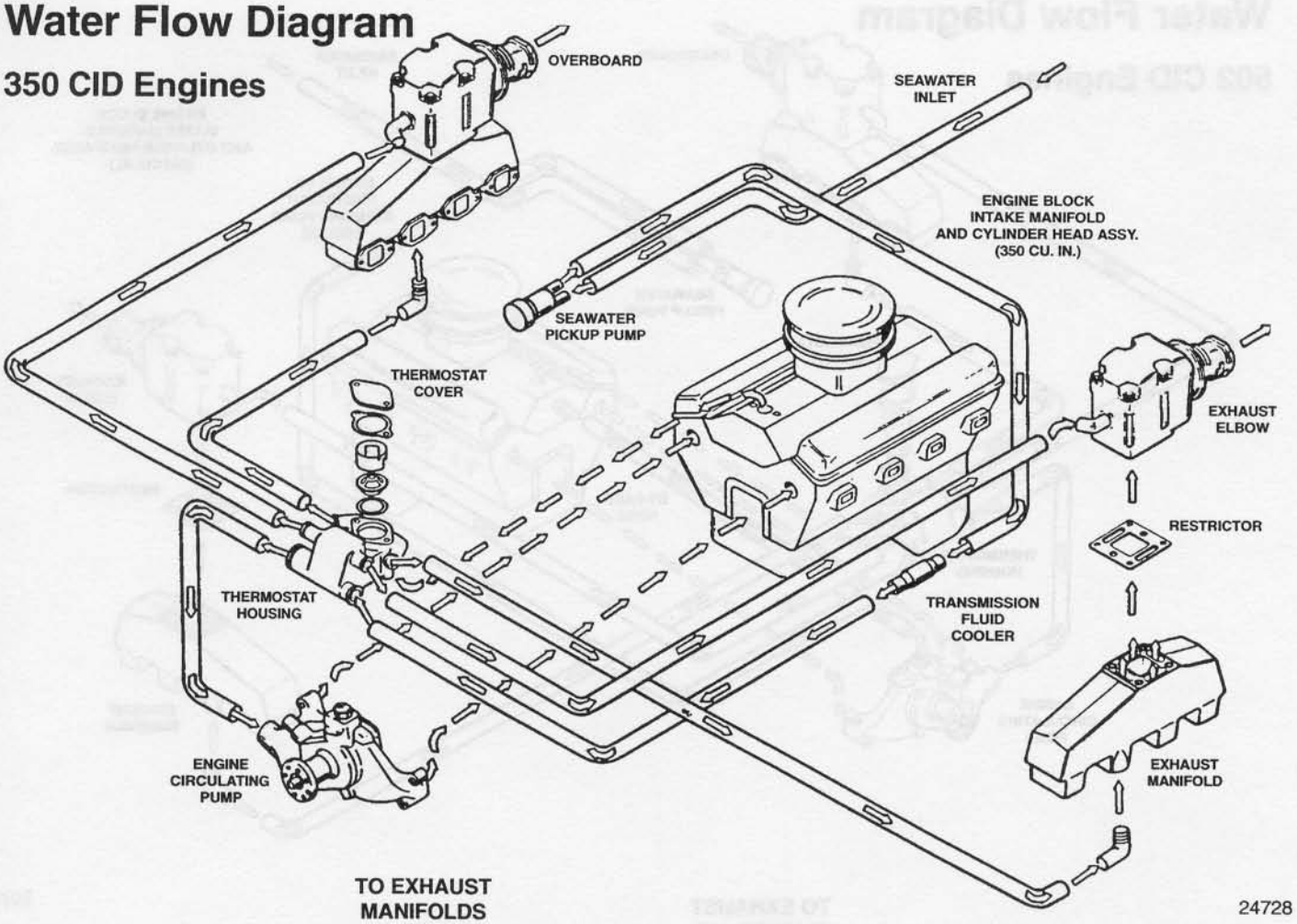
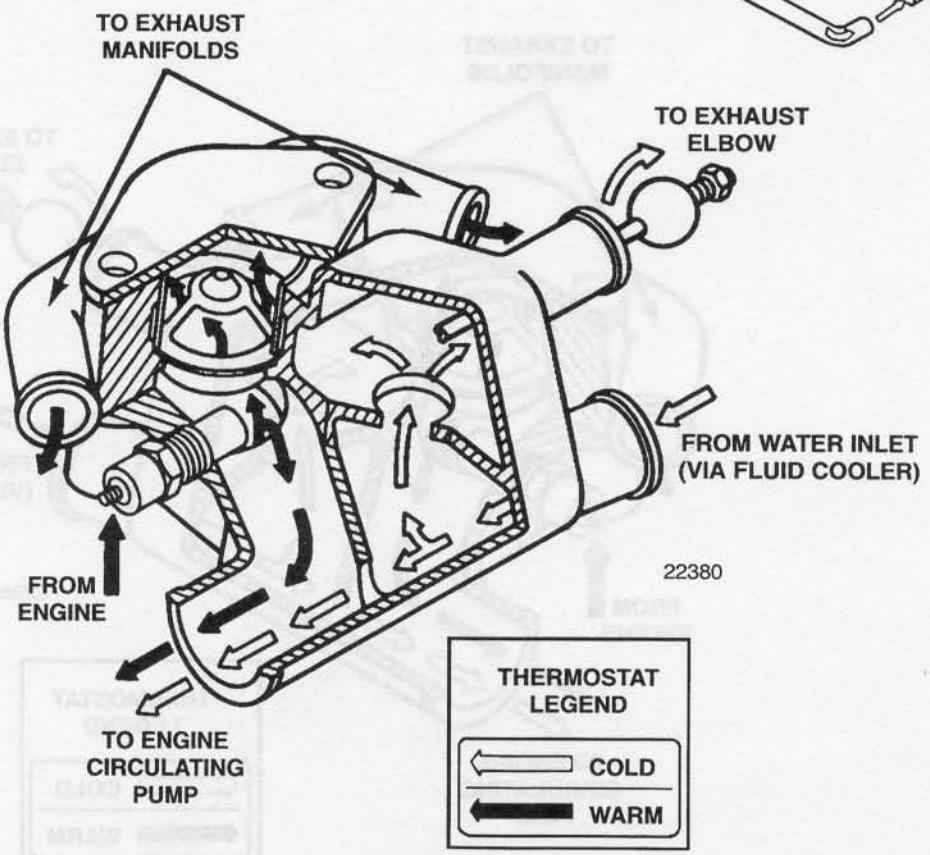
Water Flow Diagram

350 CID Engines

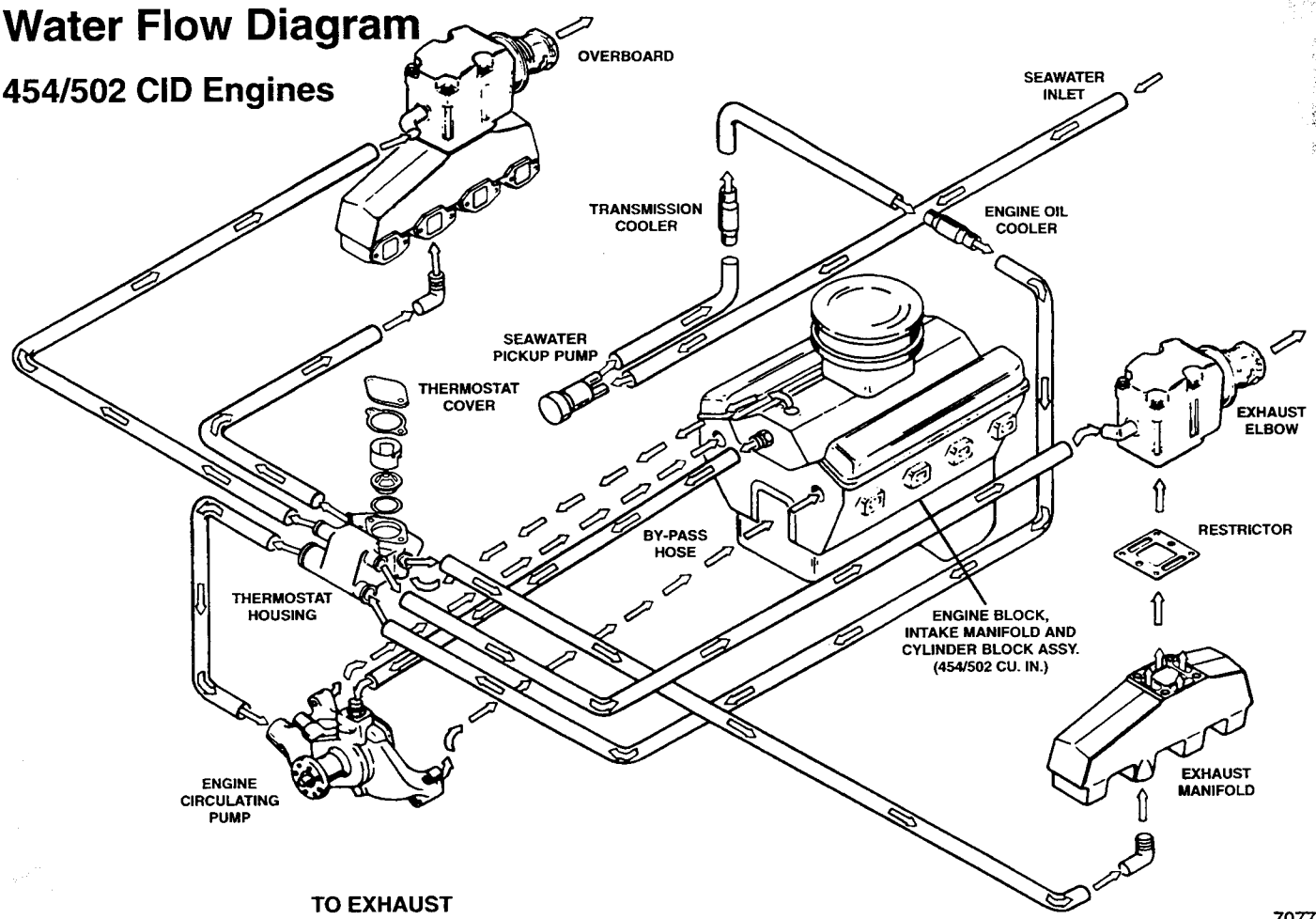




MIE - 5.0 Litre, 5.7 Litre (In-Line and V-Drive)
MIE - 5.7 Litre Competition Ski, 350 Magnum Tournament Ski

Water Flow Diagram

454/502 CID Engines



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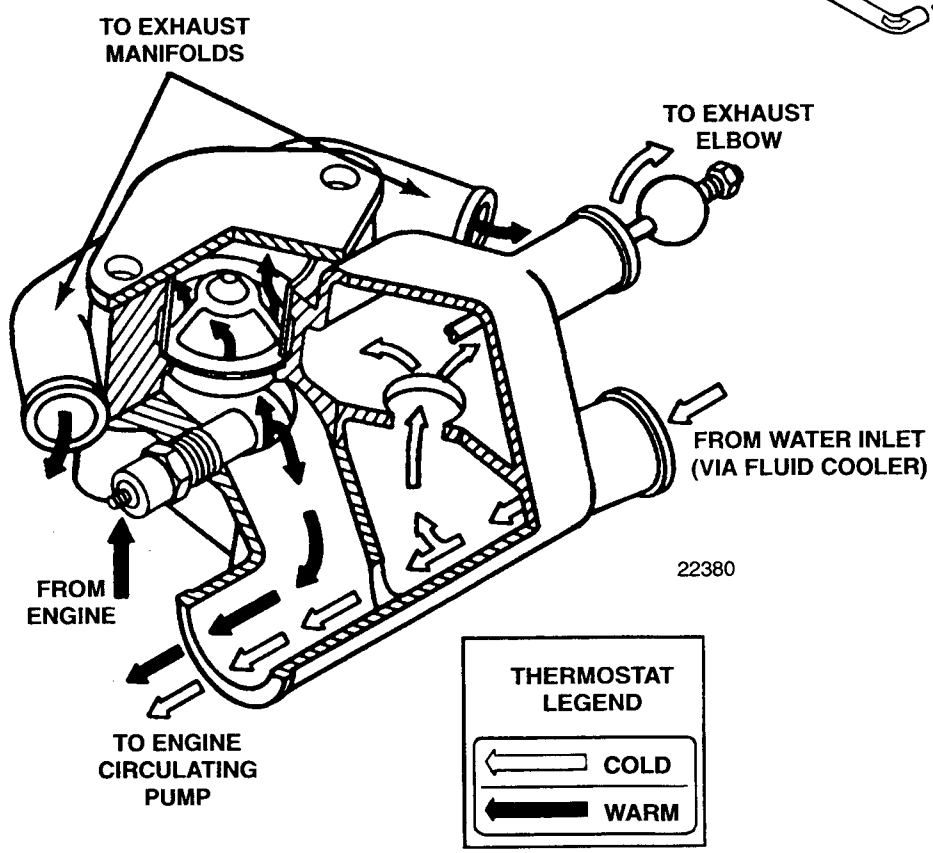

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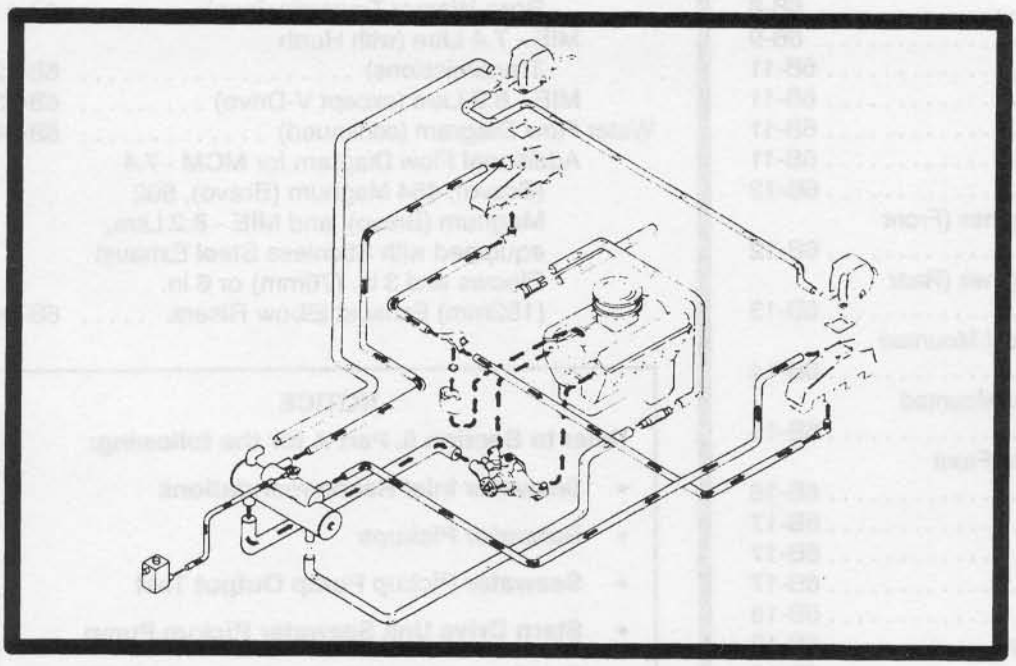
MIE - 7.4 Litre (with Hurth Transmissions)
MIE - 7.4 Litre (In-Line and V-Drive - with Borg Warner Transmissions)
MIE - 8.2 Litre

COOLING SYSTEM



CLOSED COOLING MODELS

6

B

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NOTICE

Refer to Section 6, Part A for the following:

- **Seawater Inlet Recommendations**
- **Seawater Pickups**
- **Seawater Pickup Pump Output Test**
- **Stern Drive Unit Seawater Pickup Pump**
- **Belt Driven Seawater Pickup Pump (with and without Combination Fuel Pump)**
- **Water Circulating Pump Replacement**
- **Drive Belt Tension Adjustment**
- **Flushing Seawater Cooling System**

Torque Specifications

Fastener Location	Lbs. Ft. (N·m)	Lbs. Ft. (N·m)
Drain Plugs	Securely	
Heat Exchanger End Cap		36-72 (4-8)
Heat Exchanger Mounting Brackets	Securely	
Hose Clamps	Securely	
Thermostat Cover	30 (41)	

Lubricants/Sealants

LUBRICANTS/SEALANTS	
92-86154A1	Quicksilver 2-4-C Marine Lubricant
92-34227--1	Quicksilver Perfect Seal

Specifications

CLOSED COOLING SYSTEM CAPACITY	
Model	**US Qts (litres) Approximately**
MCM/MIE 305/350 CID	20 (19)
MCM/MIE 454/502 CID	28 (26.5)

THERMOSTAT	
All Models	143° F (62° C)

PRESSURE CAP RATING	
MCM/MIE 305/350 CID MCM 454 CID MIE 7.4L	14 psi (97 kPa)
MCM 502 CID MIE 8.2L	16 psi (110 kPa)

Description

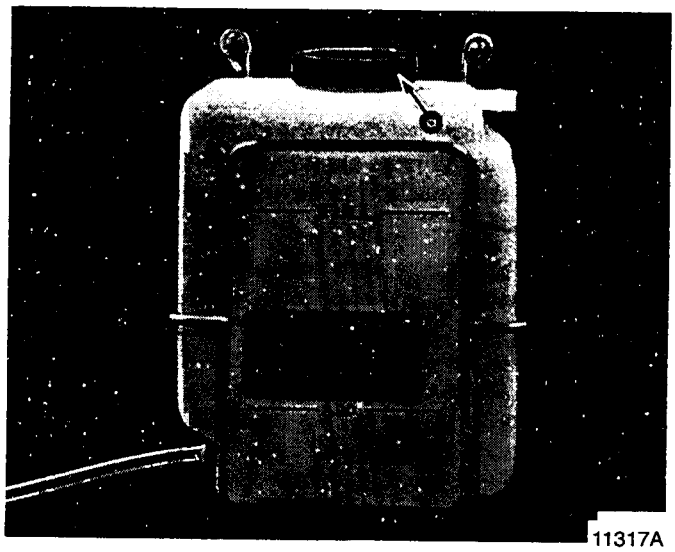
There are several configurations of this cooling system, but the operation is essentially identical. Basically, the system is composed of two separate subsystems; the seawater system and the closed cooling system. The seawater system is similar in function to the fan used in an automobile because it absorbs heat (from the closed cooling system) as it passes thru the heat exchanger. The closed cooling system is similar in function to the rest of the cooling system in an automobile.

The coolant recovery system keeps the reservoir full. Normal coolant overflow into recovery bottle is approximately 1/2 (230 mL) pint during warm-up. The coolant recovery system draws coolant back into the reservoir from the recovery bottle as the engine cools. As long as there is coolant in the recovery bottle, the reservoir should remain completely full. If not, there's a vacuum leak, usually at the hose leaving the reservoir, or the gasket under the recovery filler cap. The gasket seals against the outer rim of the filler neck.

IMPORTANT: The coolant (anti-freeze) flows around the outside of the cooling tubes while seawater flows thru the inside of the cooling tubes in the heat exchanger.

All V-8 engine exhaust manifolds are cooled by coolant in the closed cooling system. All V-8 stern drive and inboard engines use a belt driven pump to pump seawater thru the heat exchanger. Water from the seawater pickup pump in the stern drive is used to cool the stern drive only and is then dumped overboard.

Maintaining Coolant Level



a - Fill Cap

Coolant Recovery Bottle

Before starting engine each day, check to ensure that coolant is visible in coolant recovery bottle.

If coolant is not visible, check fresh water section of cooling system (including coolant recovery system) for leaks and repair, as necessary. Refill fresh water section with recommended coolant solution, as outlined under "Changing Fresh Water Coolant," following.

If coolant is visible, start engine and run until it reaches normal operating temperature, then recheck coolant level in coolant recovery bottle. Coolant level MUST BE between the "ADD" and "FULL" marks (on front of bottle).

⚠ WARNING

Allow engine to cool down before removing pressure cap, as sudden loss of pressure could cause hot coolant to boil and discharge violently. After engine has cooled down, turn cap 1/4-turn to allow any pressure to escape slowly, then, push down and turn cap all-the-way off.

If level is low, remove fill cap from coolant recovery bottle and add required amount of coolant solution. Use a 50/50 mixture of ethylene glycol anti-freeze and pure, soft water for coolant additions. If frequent additions of coolant are required, check fresh water section for leaks.

IMPORTANT: ALCOHOL OR METHANOL BASE ANTI-FREEZE OR PLAIN WATER ARE NOT RECOMMENDED FOR USE IN COOLING SYSTEM AT ANY TIME. In areas where ethylene glycol is not available, and the possibility of freezing does not exist, it is permissible to use a solution of rust inhibitor and pure, soft water (mixed to manufacturer's recommendations).

Occasionally, check to ensure that coolant recovery system is functioning properly by removing pressure cap from heat exchanger and checking level. Coolant level should be up to bottom of heat exchanger filler neck. If low, examine entire fresh water section (especially coolant recovery system) for leaks and repair, as necessary.

IMPORTANT: When reinstalling pressure cap, be sure to tighten it until it contacts stops on filler neck.

Pressure Cap Maintenance

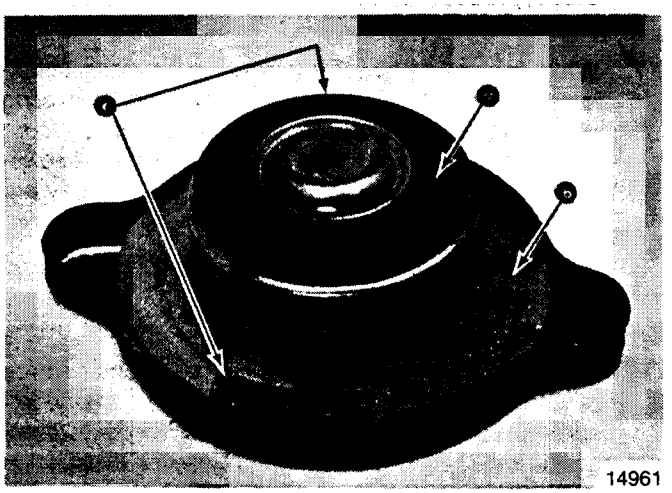
Pressure cap is designed to maintain pressure in fresh water section of Closed Cooling System once the engine has attained normal operating temperature. This raises the boiling point of the coolant, thereby increasing the efficiency of the cooling system. To help ensure proper operation, cap should be cleaned, inspected and pressure tested (at intervals specified in chart), as follows:

⚠ WARNING

Allow engine to cool down before removing pressure cap (in next step), as sudden loss of pressure could cause hot coolant to boil and discharge violently. After engine has cooled down, turn cap 1/4-turn to allow any pressure to escape slowly, then, push down and turn cap all-the-way off.

1. Remove pressure cap from heat exchanger.
2. Wash cap with clean water to remove any deposits or debris from sealing surfaces.
3. Inspect rubber seal on cap for cuts, cracks or other signs of deterioration. If seal is damaged, cap MUST BE replaced.
4. Inspect coolant recovery gasket for deterioration and replace if bad.

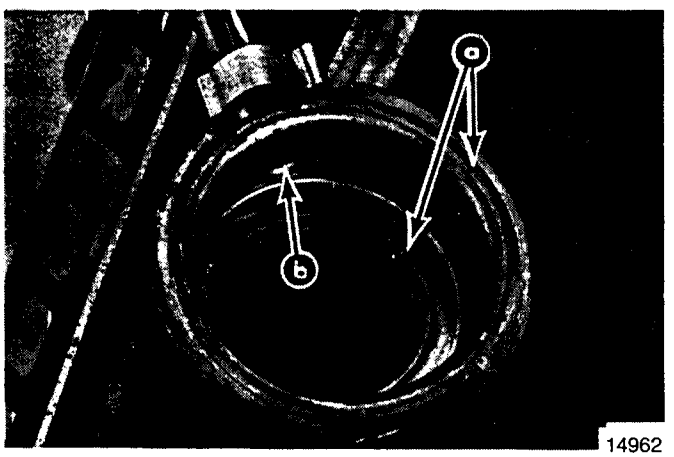
5. Check condition of locking tabs on cap. Replace cap, if tabs are bent or cracked.



a - Rubber Seal
b - Coolant Recovery Gasket
c - Locking Tabs (1 Hidden)

Pressure Cap

6. Refer to Testing - "Testing Pressure Cap" and test pressure cap as outlined.
7. Clean sealing surfaces on heat exchanger filler neck with a cloth. Inspect surfaces for any damage or deposits that may prevent cap from sealing properly.
8. Clean coolant recovery passage in heat exchanger filler neck with a wire and blow out with compressed air.
9. **Reinstall pressure cap, being sure to tighten until it contacts stops on filler neck.**



a - Pressure Cap Sealing Surface
b - Coolant Recovery Passage

Pressure Cap Sealing Surfaces on Heat Exchanger

Seawater Pickup Pump Maintenance

Seawater pickup pump should be disassembled and inspected by your Authorized MerCruiser Dealer whenever insufficient water flow is suspected.

Heat Exchanger Repair

IMPORTANT: Braze with BCUP 2 rod of silver solder. Care must be taken not to melt other joints during repair.

1. Internal leaks can be repaired by brazing shut the ends of the leaking tube. This is only a temporary fix because usually another tube will start leaking after a short period of time and this also causes a reduction in cooling capacity. Do not close more than 3 tubes.
2. Nipples and drains, that have been broken off the heat exchanger, can be re-attached by brazing.

Testing Closed Cooling System

Testing Coolant for Alkalinity

⚠ WARNING

Allow engine to cool down before removing pressure cap, as sudden loss of pressure could cause hot coolant to boil and discharge violently. After engine has cooled down, turn cap 1/4-turn to allow any pressure to escape slowly, then, push down and turn cap all-the-way off.

Coolant in fresh water section should be changed every two years and should be checked for alkalinity at least once between change intervals. To check coolant for alkalinity, proceed as follows:

1. Obtain pink litmus paper from a local supplier (drug store, pet shop, etc.).
2. Remove pressure cap from heat exchanger and insert one end of litmus paper into coolant.
3. **If pink litmus paper turns blue,** coolant is alkaline and need not be replaced.
4. **If pink litmus paper remains pink,** coolant is not alkaline and MUST BE REPLACED, as explained under "Changing Fresh Water Coolant."

Pressure Testing System

⚠ WARNING

Allow engine to cool down before removing pressure cap. Sudden loss of pressure could cause hot coolant to boil and discharge violently. After engine has cooled down, turn cap 1/4-turn to allow any pressure to escape slowly, then, push down and turn cap all-the-way off.

If coolant section of Closed Cooling System is suspected of leaking or not holding sufficient pressure, and no visible signs of leakage can be found, perform the following test:

1. Remove pressure cap from heat exchanger or reservoir.
2. Clean, inspect and pressure test pressure cap, as outlined under "Testing Pressure Cap" in this section, to eliminate the possibility that cap is not maintaining proper pressure in system and is causing coolant to boil over.
3. Clean inside of filler neck to remove any deposits or debris. Examine lower inside sealing surface for nicks or other damage. Surface must be perfectly smooth to achieve a good seal between it and rubber seal on cap. Also, check locking cams on sides of filler neck to be sure that they are not bent or damaged. If locking cams are bent or damaged, pressure cap will not hold the proper pressure.
4. Adjust coolant level in fresh water section to 1 in. (25 mm) below filler neck.
5. Attach an automotive-type cooling system pressure tester to filler neck and pressurize closed cooling section to amount specified in following chart based on pressure cap rating for your engine (refer to "Specifications").

Pressure Cap Rating	Amount of Pressure Applied to Closed Cooling System
14 psi (97 kPa)	17 psi (117 kPa)
16 psi (110 kPa)	20 psi (138 kPa)

6. Observe gauge reading for approximately 2 minutes; pressure should not drop during this time. If pressure drops, proceed with the following steps until leakage is found.
7. While maintaining specified pressure on closed cooling section, visually inspect external portion of cooling system (hoses, gaskets, drain plugs, petcocks, core plugs, circulating pump seal, etc.) for leakage. Also listen closely for bubbling or hissing, as they usually are a sure indication of a leak.
8. Refer to "Testing Heat Exchanger" in this section and test as outlined.
9. If no leakage could be found in above steps, engine is leaking internally, and it probably is due to one or more of the following: 1) Loose cylinder head bolts or damaged gasket, 2) loose intake manifold bolts or damaged gasket, 3) loose exhaust elbow or distribution block retaining nuts or damaged gasket, 4) cracked or porous cylinder head or block, 5) cracked or porous exhaust manifold. Proceed as follows until location of internal leak is found-
   a. Start engine. Repressurize system to previously specified amount and observe pressure gauge on tester. If needle in gauge vibrates, compression or combustion is leaking into closed cooling section from a leak in the combustion chamber. Exact cylinders, where leakage is taking place, sometimes can be found by removing spark plug wires (one at a time) while observing pressure gauge. Vibration will decrease or stop when plug wire is removed from leaking cylinder. Stop engine.
   b. Remove spark plugs (one at a time) from cylinders and examine for presence of coolant. A spark plug, that is perfectly clean or milky appearing, is a sure indication of a leak.
   c. Drain oil from engine and examine for presence of coolant. Oil usually will be milky, if coolant is present. If coolant is present, remove engine from boat and drop the oil pan. With engine in the upright position, repressurize closed cooling section to previously specified amount and examine internal surfaces of engine to locate leak.
   d. If no leakage can be found in above steps, entire engine must be disassembled and inspected for leakage.

Testing for Cylinder Head Gasket Leak

A leaking head gasket will cause combustion gas to be forced into the cooling system. The mixture of coolant and tiny air bubbles is a poor heat conductor; and will overheat an engine quickly. Compression tests or cooling system pressure check normally will not detect the leak because the test pressure is far below the combustion pressures which cause the leak. An effective test is as follows:

IMPORTANT: Run boat in lake for this test. It is best to run the engine at or above cruising speed during this test. Usually a failed head gasket will not cause the engine to overheat below cruising speed.

1. Install a clear plastic hose between the reservoir and coolant recovery bottle. Use a 2-3 ft. (61-91 cm) long hose for this test.
2. Route this hose so a "U" is formed.
3. Put enough coolant into hose to fill the center 4 or 5 inches (10-13 cm) of the "U".
4. Observe the "U" while the engine is running.
   a. During idle and warm-up: some coolant and/or air will leave the reservoir.
   b. During cruising speed (2500-3500 RPM); coolant and/or air leaving the reservoir should stop after approximately 5 minutes running at a given RPM. A leaking head gasket will produce air bubbling through the "U", going to the coolant recovery bottle. The frequency and size of the bubbles will depend on the size of the leak.
   c. At higher speeds (4000 + RPM): Normal operation is the same as described in "b" above. A failed head gasket will cause the bubbles to come faster and may be accompanied by violent, intermittent bursts of coolant.

It is important not to confuse normal warm-up expansion with a failed head gasket. Normal warm-up produces an intermittent flow of coolant which will stop within approximately 5 minutes at a given RPM. A head gasket leak will not stop - the one thing that marks a failed head gasket is the continued passage of air, that may be accompanied by violent, intermittent bursts of coolant leaving the reservoir. If coolant continues to flow (not in violent, intermittent bursts) from the reservoir at cruising speed, something else besides the head gasket is causing the engine to overheat.

Testing Heat Exchanger

For Internal Leak: An internal leak will cause coolant to go into the seawater circuit when pressure is put on the closed cooling circuit.

a. Remove a seawater hose from the exchanger. Do not drain the exchanger.
b. Pressurize the closed cooling circuit to 14-20 psi (97-138 kPa) with a radiator tester.
c. If seawater begins to flow from the nipple there is a leak.

For Blockage:

IMPORTANT: Seawater flows THROUGH the tubes in the exchanger. Closed cooling coolant flows AROUND the tubes.

a. Remove end caps and inspect for any blockage in the seawater circuit (broken impeller blades, weeds, etc.).
b. Remove closed cooling circuit hoses and inspect the tubes just inside the nipples. Because the complete exchanger cannot be inspected, the heat exchanger should be replaced if blockage is suspected.

Testing Pressure Cap

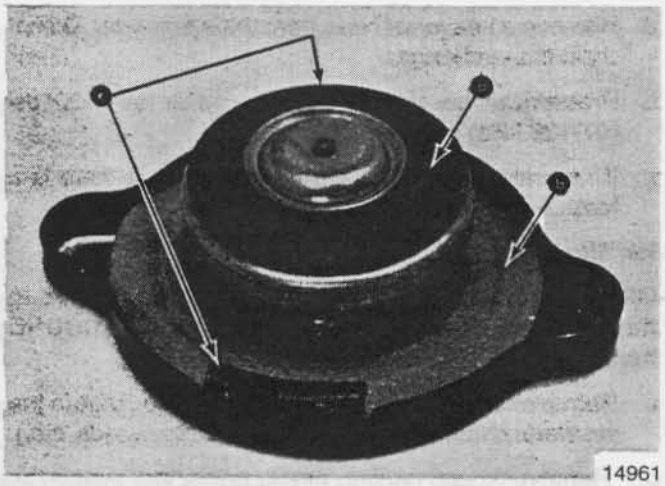
Pressure cap is designed to maintain a pressure of approximately its rated capacity (refer to specifications) in closed cooling section once engine has attained operating temperature. Cap should be cleaned, inspected and pressure-tested at regular tune-up intervals or whenever cap is suspected of maintaining improper pressure, as follows:

⚠ WARNING

Allow engine to cool down before removing pressure cap. Sudden loss of pressure could cause hot coolant to boil and discharge violently. After engine has cooled down, turn cap 1/4-turn to allow any pressure to escape slowly, then, push down and turn cap all-the-way off.

1. Carefully remove pressure cap from reservoir or heat exchanger.
2. Wash cap with clean water to remove any deposits or debris from sealing surfaces.

3. Inspect gasket (if used) and rubber seal on cap for tears, cuts, cracks or other signs of deterioration. Replace gasket, if damaged, or entire cap, if rubber seal is damaged.



a - Rubber Seal (Cap MUST BE Replaced if Damaged)
b - Gasket (Look for Cracks under Gasket)
c - Locking Tabs (1 Hidden)

Pressure Cap

4. Check that locking tabs on cap are not bent or damaged.

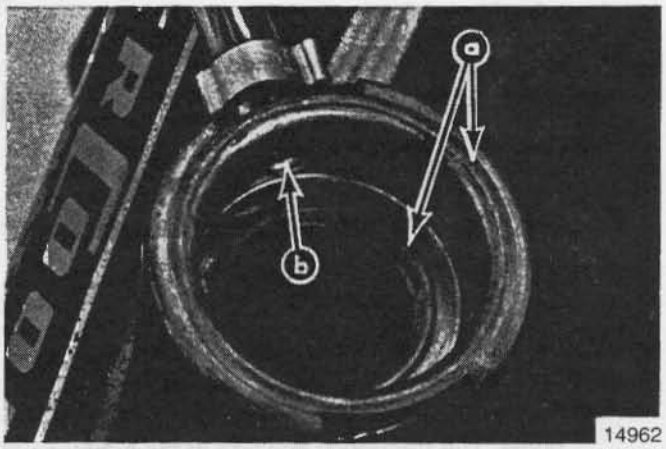
5. Using a cooling system pressure tester (similar to one shown), test cap to be sure that it releases at proper pressure and does not leak. (Refer to instructions which accompany tester for correct test procedure.) Cap must relieve pressure at specified model rating psi (kPa) (see chart) and must hold rated pressure for 30 seconds without going below 11 psi (76 kPa). Replace cap if it fails to fall within these limits.

Pressure Testing Pressure Cap

Model	Pressure Cap Rating
MCM/MIE 305/350 CID MCM 454 CID MIE 7.4L	14 psi (97 kPa)
MCM 502 CID MIE 8.2L	16 psi (110 kPa)

IMPORTANT: Before reinstalling cap in next step, examine lower inside sealing surface in filler neck to ensure that it is perfectly smooth and free of debris. Also, inspect cam lock flanges on sides of filler neck to be sure that they are not bent.

6. Reinstall cap on reservoir or heat exchanger.



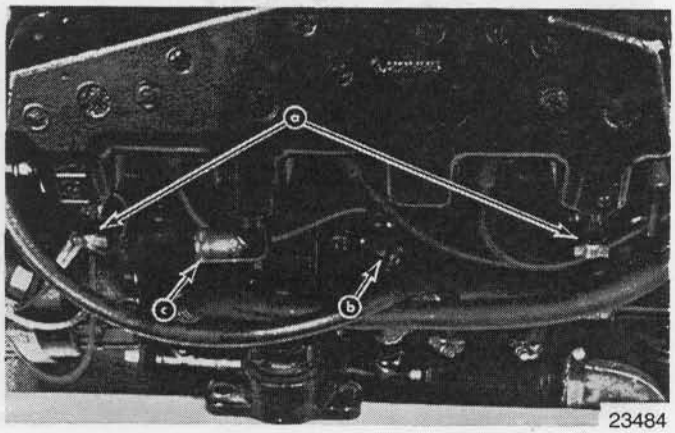
a - Inspect for Damage
b - Clean Coolant Recovery Passage

Heat Exchanger

Thermostat

Removal

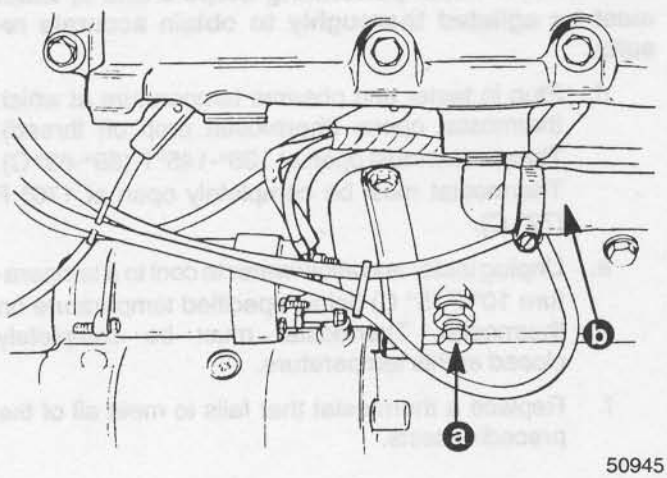
1. Follow instructions "a" and "b":
   a. Drain coolant from exhaust manifolds by removing lower hose from each manifold, and removing plugs, or opening petcocks, if so equipped, on each manifold. Be sure to drain both port and starboard sides.
   b. Drain engine block by removing plug or opening petcocks. Be sure to drain both port and starboard sides.



23484

a - Petcock [Exhaust Manifold (or Plug, if so equipped)]
b - Petcock (Cylinder Block)
c - Hose Location (Hose Already Removed)

Earlier Models, Port Side Shown (Starboard Similar)

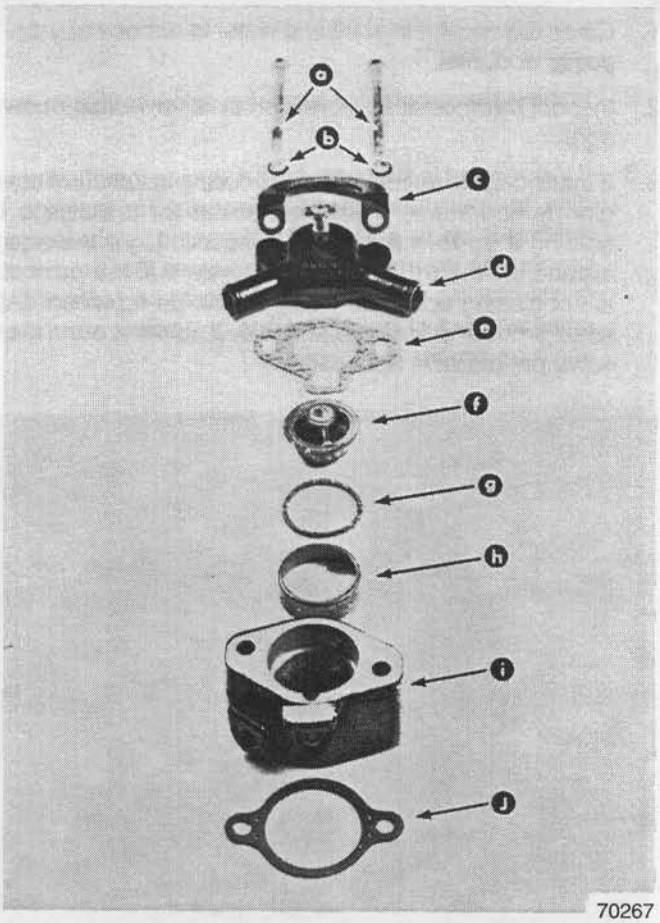


50945

a - Drain Plug (Cylinder Block)
b - Hose

Later Models, Port Side Shown (Starboard Similar)

2. Diconnect hoses from thermostat cover.
3. Remove thermostat cover attaching bolts and lockwashers, then remove cover and gasket.
4. Remove thermostat from thermostat housing.



70267

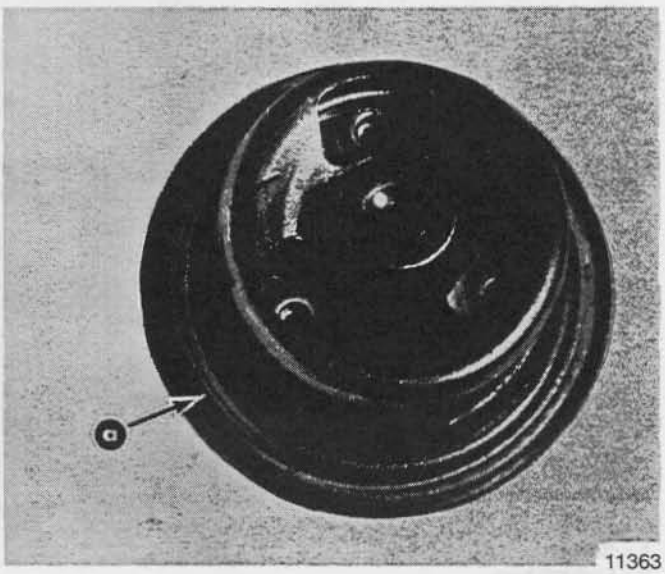
a - Screws
b - Lockwashers
c - Lifting Eye
d - Top Cover [with Bleeder Valve - Petcock (See Note 1.)]
e - Upper Gasket
f - Thermostat
g - Cork Gasket (See Note 2.)
h - Sleeve (See Note 2.)
i - Thermostat Housing (See Note 2.)
j - Lower Gasket (with Continuity Rivets)

NOTE 1: Not all top covers have a petcock. Some covers have a threaded plug in place of petcock and others are plain, without either.

NOTE 2: Not all thermostat housings are designed to utilize the sleeve and cork gasket shown. Some later style housings have a shallow counter bore on top of housing in which the thermostat is placed, without use of sleeve or cork gasket.

Testing

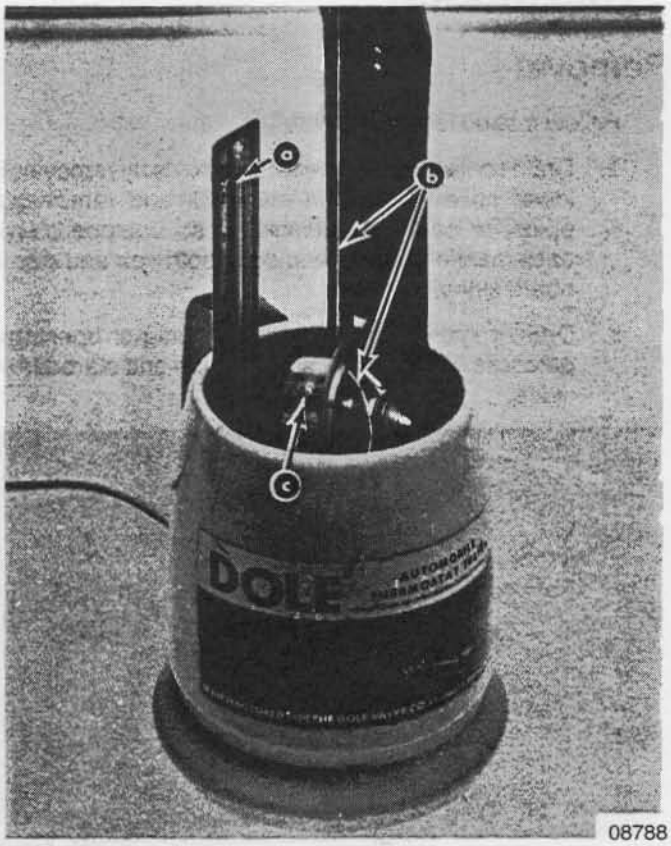
1. Clean thermostat in soap and water to remove any deposits or debris.
2. Inspect thermostat for corrosion or other visible damage.
3. If thermostat is suspected of producing insufficient engine temperature, check thermostat for leakage by holding it up to a lighted background. Light leakage around the thermostat valve indicates that thermostat is not closing completely and should be replaced. (A small amount of leakage at one or 2 points around the valve perimeter is acceptable.)



a - Check for Light Leakage Around Perimeter of Valve

Checking Typical Thermostats for Leakage

4. Check opening and closing temperature of thermostat (using a tester similar to the one shown), as follows:
   a. Fill tester to within 1 in. (25 mm) of top with tap water. Do not use distilled water.
   b. Open thermostat valve and insert thread. Position thermostat on nylon string so that it will be just below water level when suspended, then allow valve to close. Suspend thermostat in water.
   c. Place thermometer in container and position so that bottom of thermometer is even with bottom of thermostat. Do not allow thermometer to touch container.



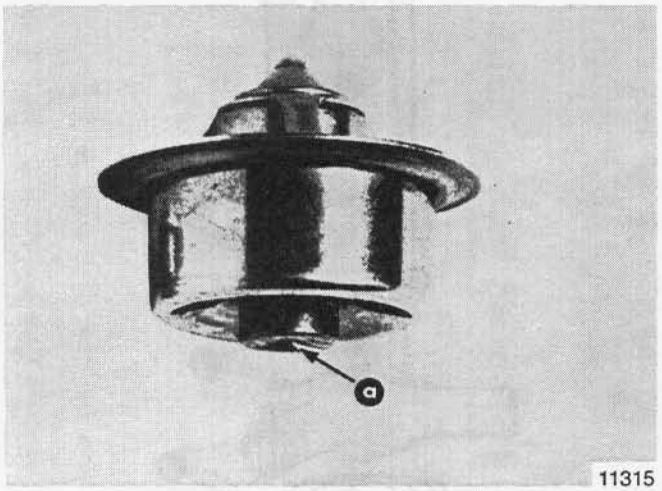
a - Thermometer
b - Nylon String
c - Thermostat

Thermostat Tester

IMPORTANT: When performing Steps d and e, water must be agitated thoroughly to obtain accurate results.

   d. Plug in tester and observe temperature at which thermostat opens (thermostat drop off thread). Thermostat must open at 138°-145° F (59°-63° C). Thermostat must be completely open at 170° F (77° C).
   e. Unplug tester and allow water to cool to a temperature 10° F (5° C) below specified temperature on thermostat. Thermostat must be completely closed at this temperature.
   f. Replace a thermostat that fails to meet all of the preceding tests.

Installation



a - Install Thermostat with This End Toward Thermostat Housing

Typical Thermostat Installation

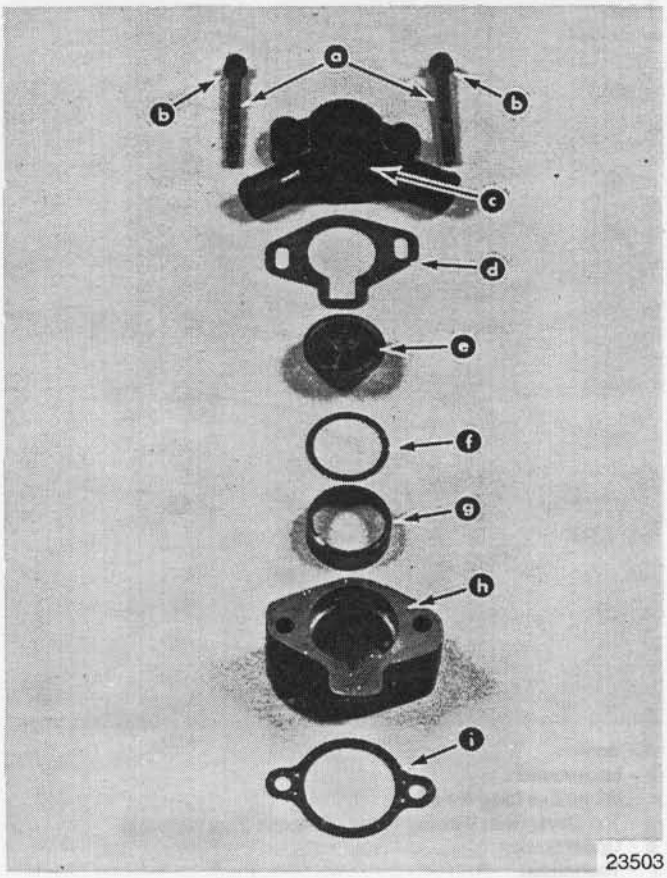
⚠CAUTION

Do not operate engine without cooling water being supplied to seawater pickup pump, or pump impeller will be damaged.

1. Remove thermostat housing and gaskets. Discard gaskets.
2. Clean gasket surfaces on thermostat cover, thermostat housing and intake manifold.
3. Position lower gasket (with continuity rivets) on intake manifold. Place thermostat housing on gasket.

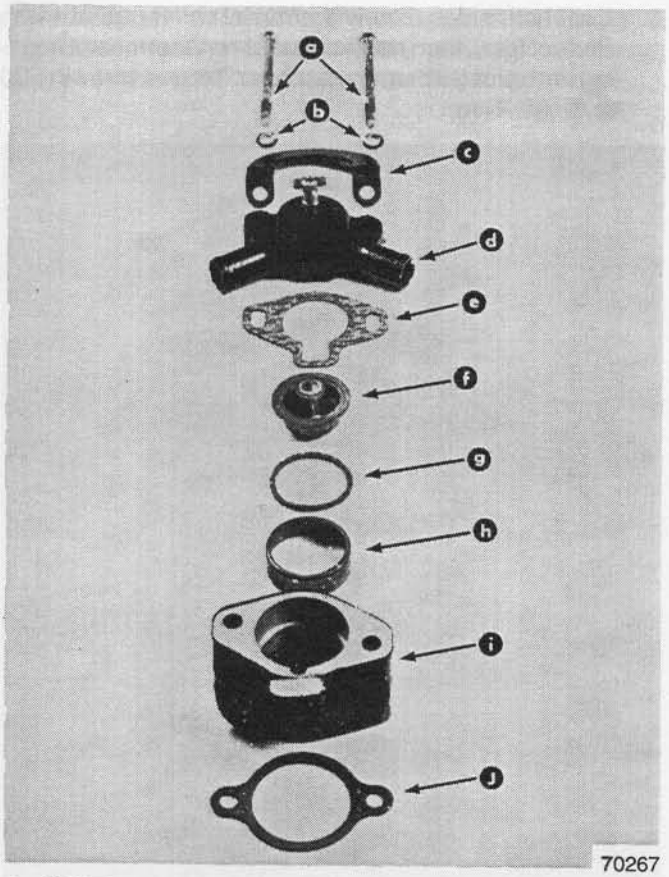
IMPORTANT: If gasket has continuity rivets, do not coat with Perfect Seal or Audio Warning temperature switch may not work properly.

4. If so equipped, install retaining sleeve (with turned-in-edge facing up) in thermostat housing and place new cork gasket on sleeve.
5. Install thermostat as previously shown, into thermostat housing (placed on cork gasket and sleeve if so equipped).
6. Coat both sides of new thermostat cover gasket with Perfect Seal, then position gasket on thermostat housing and reinstall thermostat cover. Torque screws to 30 lb. ft. (41 N·m).



a - Thermostat Cover Attaching Screws
b - Lockwashers
c - Thermostat Housing Cover (from Kit)
d - Upper Gasket
e - Thermostat (Original)
f - Cork Gasket
g - Sleeve (Turned-in-Edge Up)
h - Thermostat Housing
i - Lower Gasket (with Continuity Rivets)

305/350 CID Engines



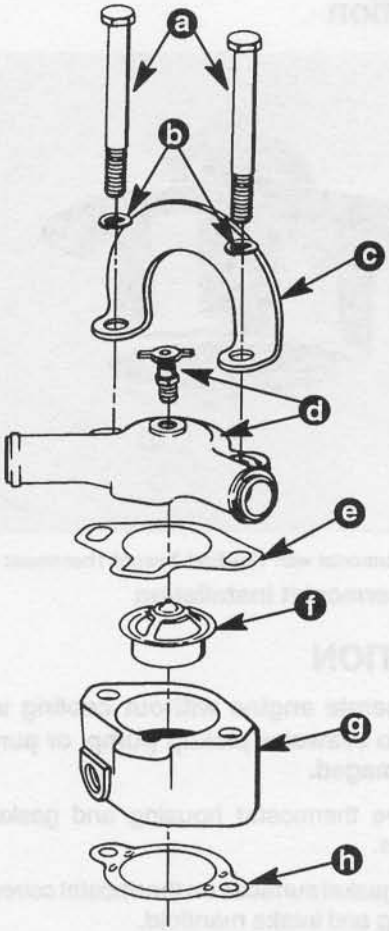
70267

a - Screws
b - Lockwashers
c - Lifting Eye (See Note 1.)
d - Top Cover [with Bleeder Valve - Petcock (See Note 2.)]
e - Upper Gasket
f - Thermostat
g - Cork Gasket
h - Sleeve (Turned-in-Edge Up)
i - Thermostat Housing
j - Lower Gasket (with Continuity Rivets)

454/502 CID Engines (with Sleeve)

NOTE 1: Not present on all models.

NOTE 2: Not all top covers have a petcock. Some covers have a threaded plug in place of petcock and others are plain, without either.



71266

a - Screws
b - Lockwashers
c - Lifting Eye
d - Top Cover with Petcock [or Plug (not Shown)]
e - Upper Gasket
f - Thermostat
g - Thermostat Housing
h - Lower Gasket (with Continuity Rivets)

454/502 CID Engines (Without Sleeve)

7. Connect hoses to thermostat cover. Tighten hose clamps securely.

⚠CAUTION

Avoid seawater pickup pump impeller damage. DO NOT operate engine without cooling water being supplied to seawater pickup pump.

8. With boat in the water and/or cooling water properly supplied to seawater pickup pump, start engine and inspect for leaks.

Changing Coolant

Coolant Recommendations

⚠CAUTION

Alcohol or Methanol base anti-freeze or plain water, are not recommended for use in fresh water section of cooling system at any time.

It is recommended that the coolant section of Closed Cooling System be filled with a 50/50 mixture of ethylene glycol anti-freeze and water. In areas where the possibility of freezing DOES NOT exist, it is permissible to use a solution of rust inhibitor and water (mixed to manufacturer's recommendations).

Change Intervals

The old coolant should be drained and flushed from the closed cooling system at least every two (2) years or whenever exhaust gases have entered into the system.

Draining Instructions

⚠WARNING

Allow engine to cool down before removing pressure cap. Sudden loss of pressure could cause hot coolant to boil and discharge violently. After engine has cooled down, turn cap 1/4-turn to allow any pressure to escape slowly, then, push down and turn cap all-the-way off.

IMPORTANT: A wire should be repeatedly inserted into drain holes to ensure that foreign material is not obstructing the drain holes. On later models with two piece petcocks, removal of petcock may be required so that wire can be inserted completely into drain hole.

IMPORTANT: Engine must be as level as possible to ensure complete draining of cooling system.

IMPORTANT: Closed cooling section must be kept filled year-round with recommended coolant. If engine will be exposed to freezing temperatures, make sure closed cooling section is filled with an ethylene glycol anti-freeze and water solution properly mixed to protect engine to lowest temperature to which it will be exposed.

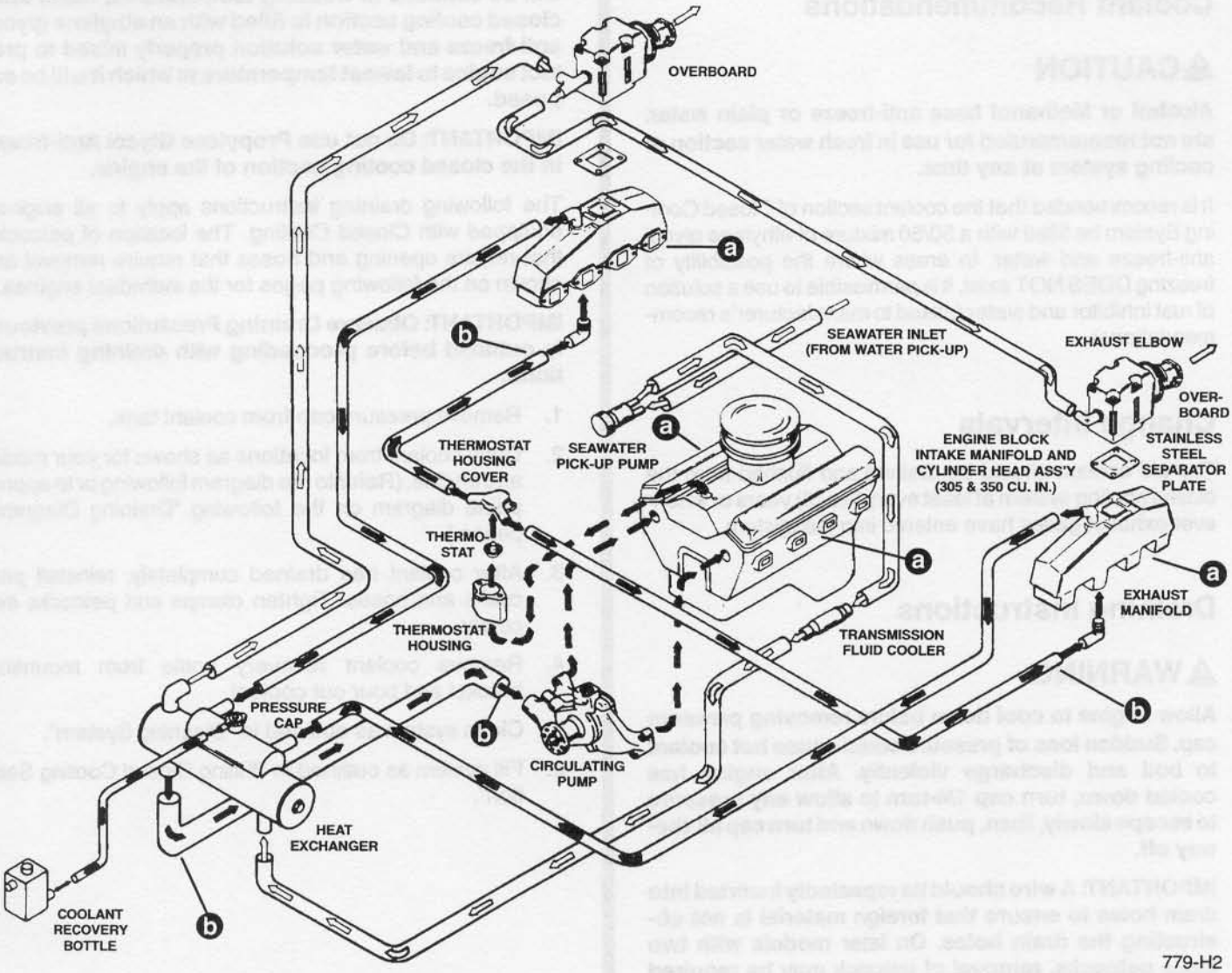
IMPORTANT: Do not use Propylene Glycol Anti-freeze in the closed cooling section of the engine.

The following draining instructions apply to all engines equipped with Closed Cooling. The location of petcocks that require opening and hoses that require removal are shown on the following pages for the individual engines.

IMPORTANT: Observe Draining Precautions previously outlined before proceeding with draining instructions.

1. Remove pressure cap from coolant tank.
2. Drain coolant from locations as shown for your model and engine. (Refer to the diagram following or to appropriate diagram on the following "Draining Diagram" pages.)
3. After coolant has drained completely, reinstall petcocks and hoses. Tighten clamps and petcocks securely.
4. Remove coolant recovery bottle from mounting bracket and pour out coolant.
5. Clean system as outlined in "Cleaning System".
6. Fill system as outlined in "Filling Closed Cooling Section".

Draining Diagram - MCM/MIE 305/350 CID Engines

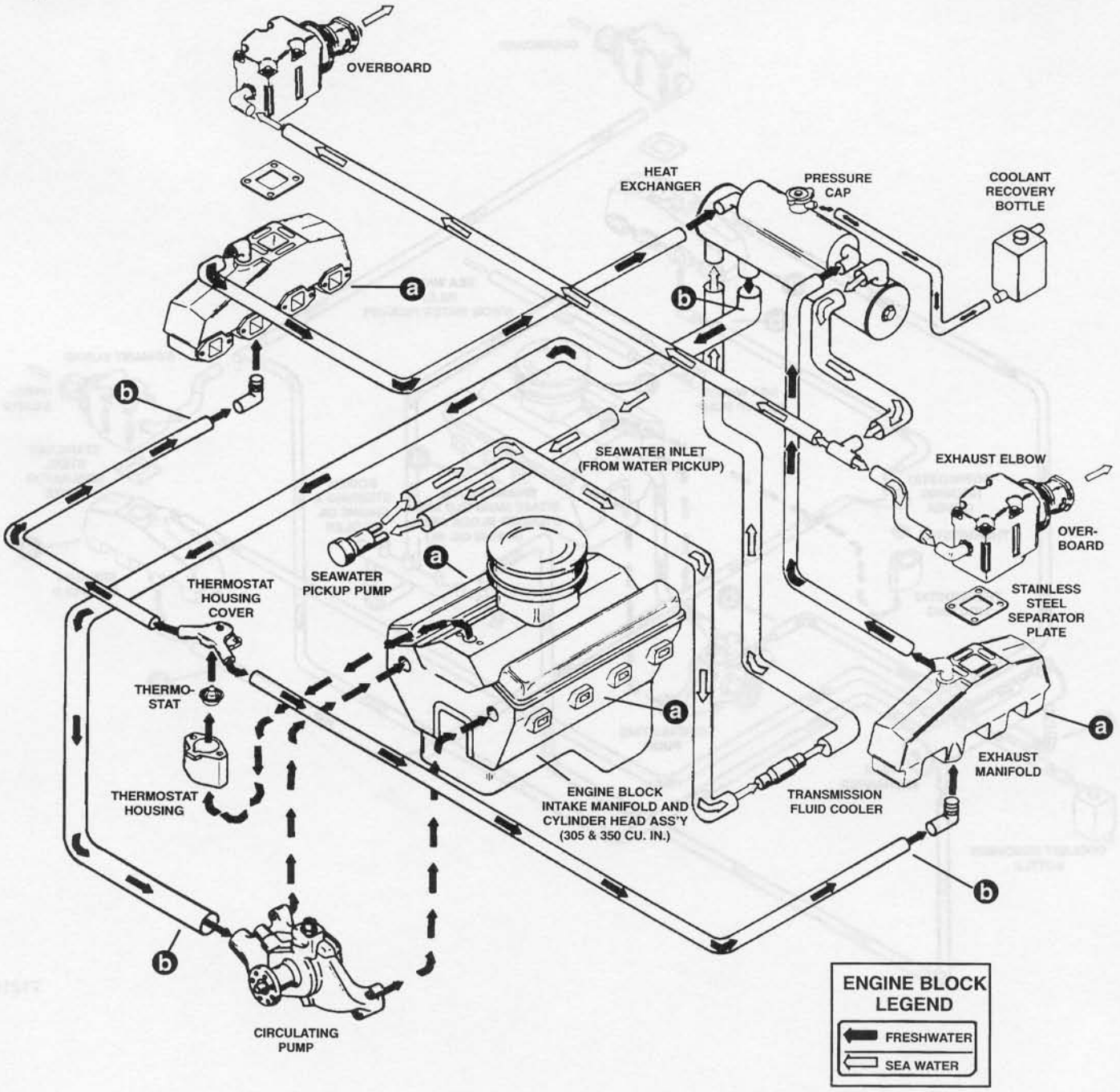


779-H2

a - Remove Petcock
b - Remove Hose (Lower to Drain)

Front Mounted Tank

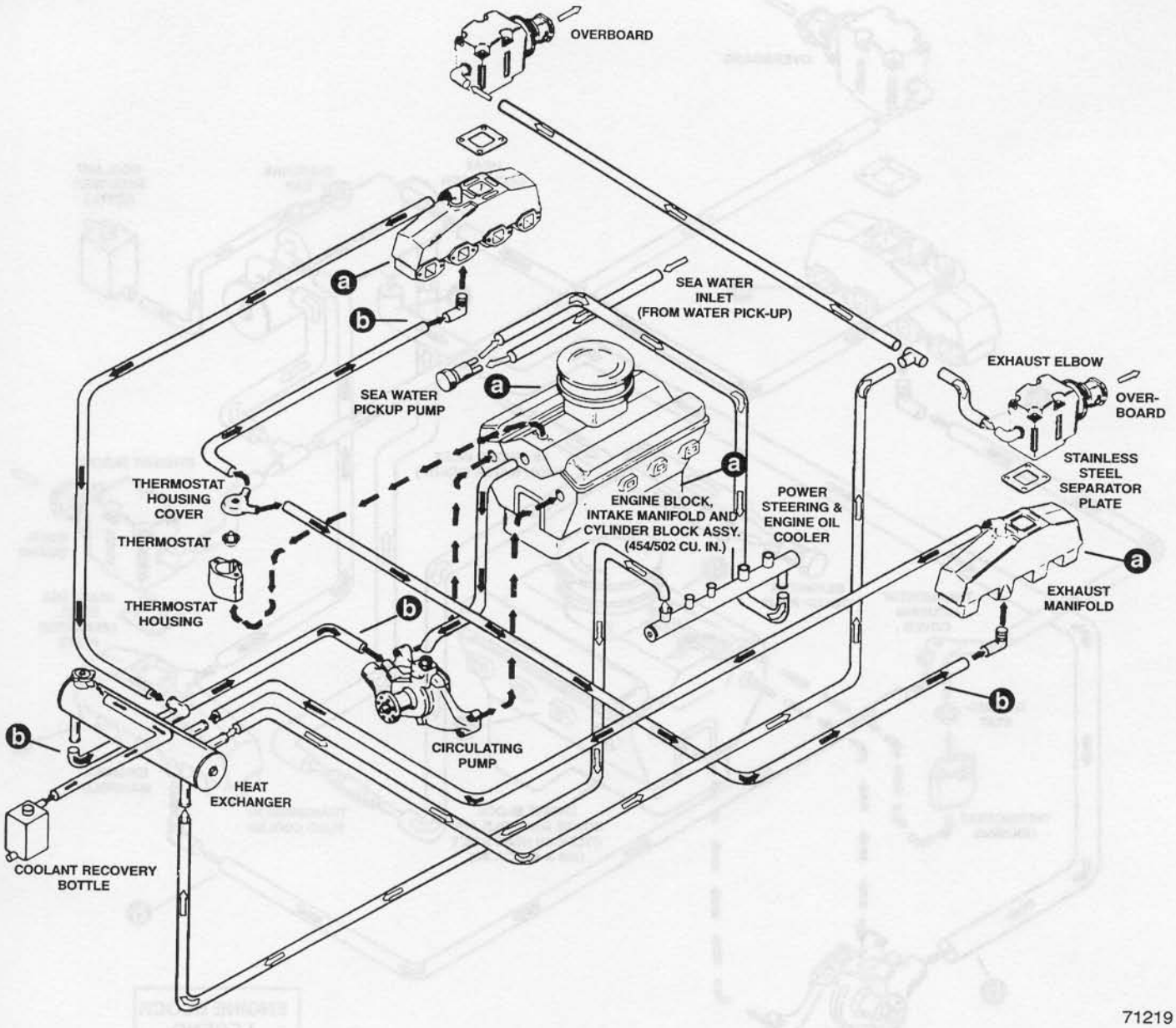
Draining Diagram - MCM/MIE 305/350 CID Engines



a - Remove Petcock
b - Remove Hose (Lower to Drain)

Rear Mounted Tank

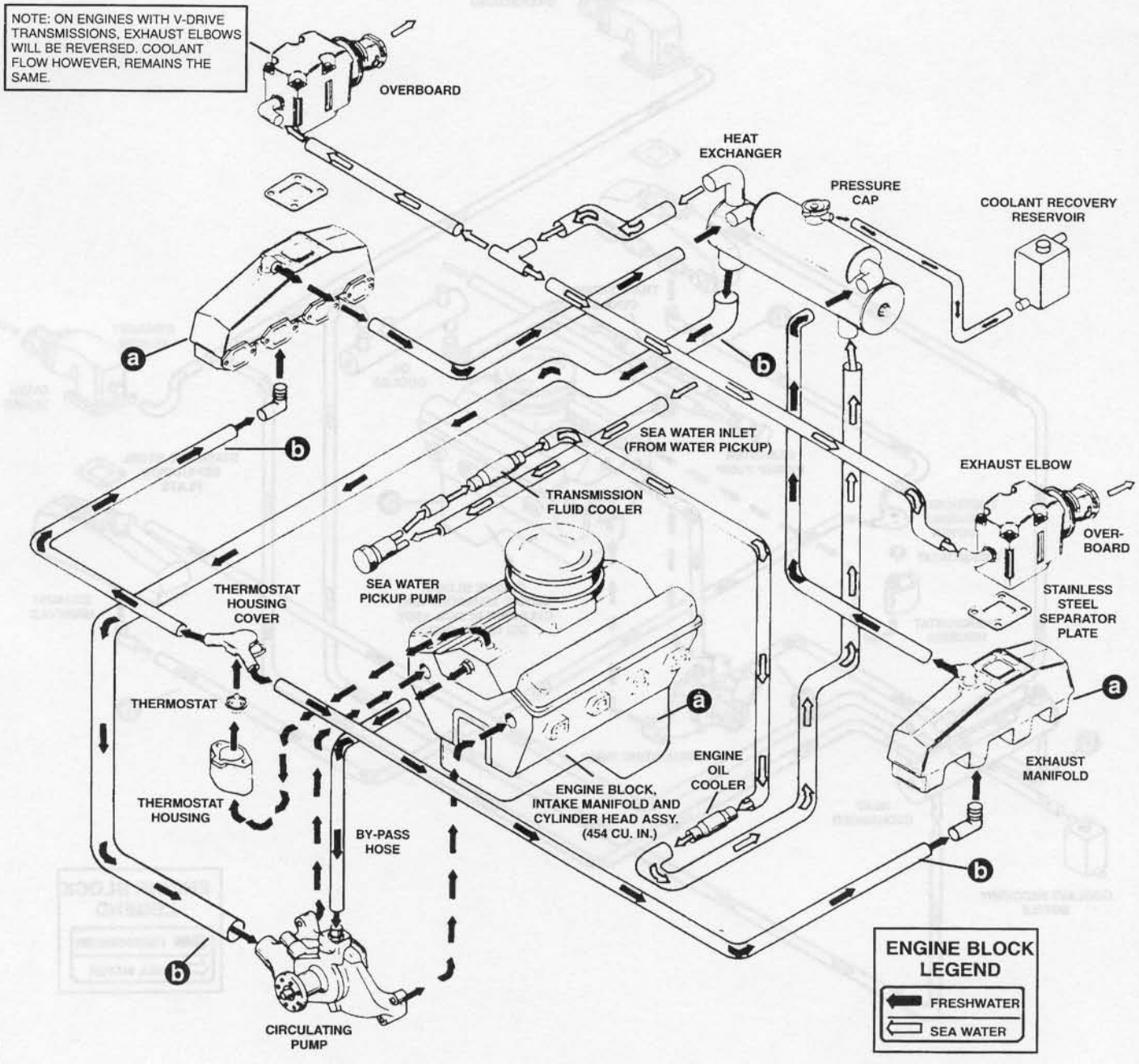
Draining Diagram - MCM 454 CID Engines



a - Remove Petcock
b - Remove Hose (Lower to Drain)

Front Mounted Tank

Draining Diagram - MIE 454 CID Engines

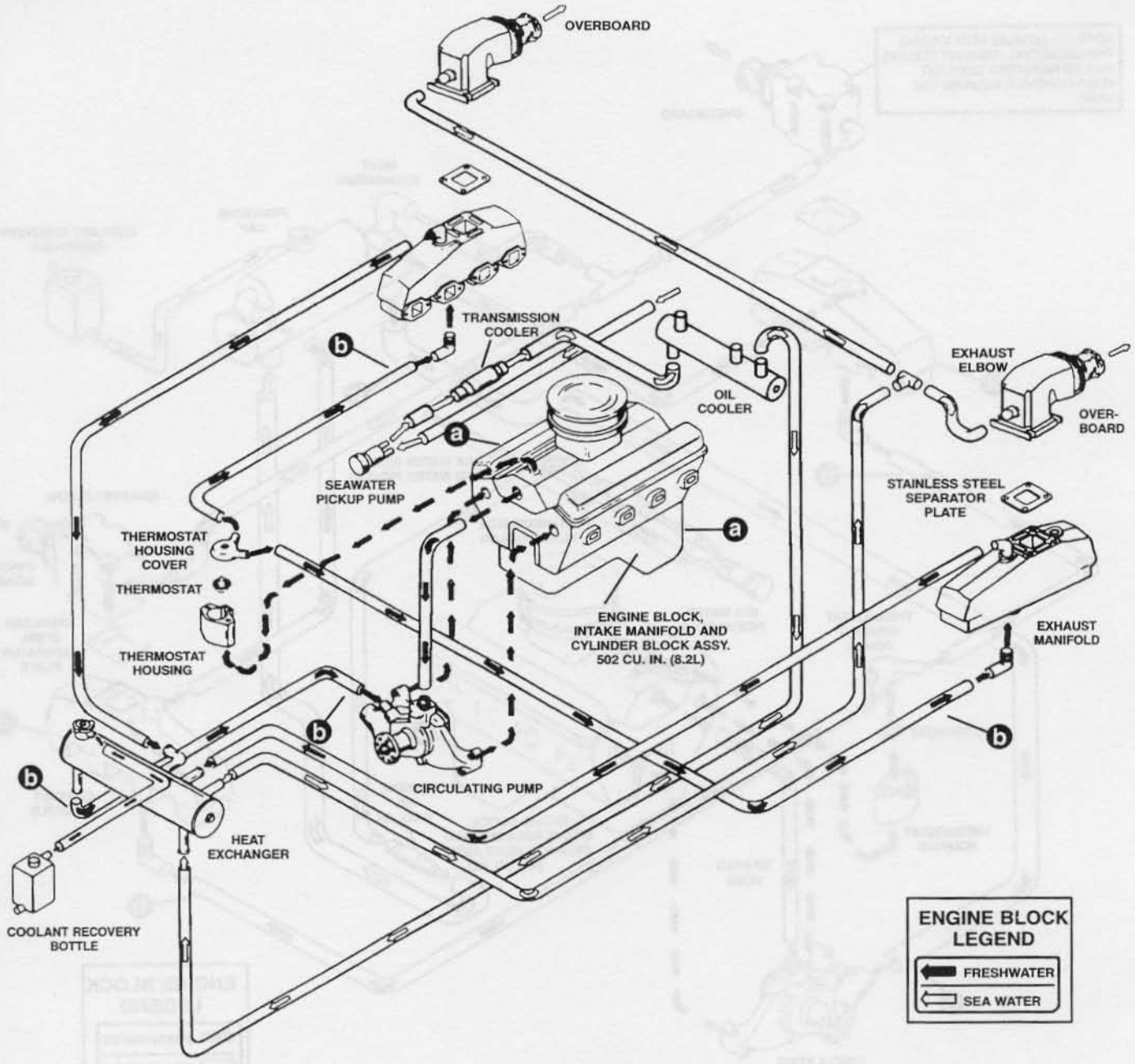


779-H1

a - Remove Petcock
b - Remove Hose (Lower to Drain)

Rear Mounted Tank

Draining Diagram - MCM/MIE 502 CID Engines



70781

a - Remove Petcock
b - Remove Hose (Lower to Drain)

Front Mounted Tank

Cleaning System

Closed Cooling Section

Closed cooling section of Closed Cooling System should be cleaned at least once every 2 years or whenever decreased cooling efficiency is experienced.

A good grade automotive cooling system cleaning solution may be used to remove rust, scale or other foreign material. Manufacturer's instructions, which accompany particular cleaner, always should be followed.

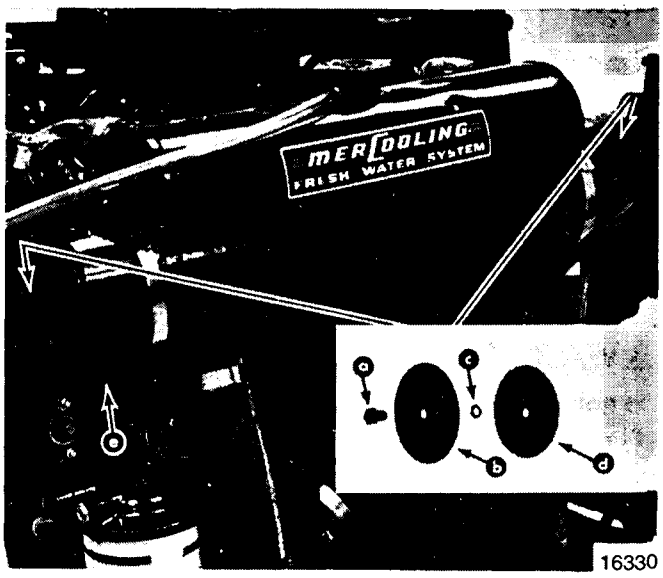
If closed cooling section is extremely dirty, a pressure flushing device may be used to flush out remaining deposits. Flushing should be done in direction opposite normal coolant flow to allow water to get behind deposits and force them out. Refer to instructions which accompany flushing device for proper hookup and flushing procedure.

Seawater Section

Cooling efficiency of an engine with Closed Cooling is greatly dependent upon heat transfer through the tubes within the heat exchanger. During engine operation, contaminants within the seawater (such as salt, silt, lime, etc.) collect on the inside of the tubes, thus reducing heat transfer and greatly decreasing heat exchanger efficiency. It is, therefore, recommended that the seawater section of the heat exchanger be cleaned at least once every 2 years or whenever decreased cooling efficiency is suspected, as follows:

IMPORTANT: It may be necessary to remove heat exchanger on some models. If heat exchanger is removed, be sure to refill closed cooling section with coolant.

1. Remove seawater drain plug from bottom of heat exchanger and allow water to drain. After water has drained completely, coat threads of drain plug with Perfect Seal and reinstall.



a - Bolt
b - End Cap
c - Sealing Washer
d - Gasket
e - Drain Plug (Refer to "Out-of-Season Storage" for Location on Model Being Worked On)

Typical V-8 Engine

2. Remove bolts, which secure end plates to each end of heat exchanger, then remove end plates, seal washers and gaskets. Discard seal washers and gaskets. Clean gasket material from end plates and heat exchanger.
3. Clean water passages in heat exchanger by inserting a suitable size wire brush into each passage. Use compressed air to blow loose particles out of water passages.
4. Apply Perfect Seal to both sides of new end plate gaskets, then reinstall end plates, using new gaskets and seal washers. (Be sure to install seal washers between end plates and gaskets.) Torque end plate bolts to specifications.

⚠CAUTION

Avoid seawater pickup pump impeller damage. DO NOT operate engine without water being supplied to seawater pickup pump.

5. With boat in the water and/or cooling water properly supplied to seawater pickup pump, start engine and inspect for leaks.

Filling Closed Cooling Section

NOTICE

See "Specifications" for approximate closed cooling system capacity and coolant recommendation.

⚠WARNING

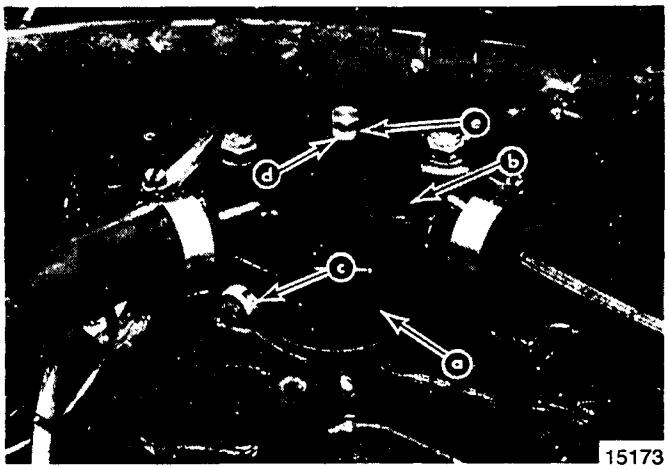
Do not remove coolant cap when engine is hot. Coolant may discharge violently.

⚠CAUTION

• Alcohol or Methanol based anti-freeze or plain water, are not recommended for use in fresh water section of cooling system at any time.

• Front of engine should be higher than rear to purge trapped air out of the system during initial filling. This will minimize the possibility of air being trapped in the closed cooling section which can cause engine to overheat.

1. Remove coolant cap on heat exchanger.
2. Depending on thermostat housing and cover configuration, follow instructions "a", "b" or "c":
   a. **On thermostat housings with pipe plug and without hex plug or petcock (on housing cover):** Remove pipe plug.
   b. **On thermostat housings with hex plug on housing cover:** Remove hex plug.
   c. **On thermostat housings with petcock on housing cover:** Open petcock.



15173

a - Thermostat Housing
b - Thermostat Housing Cover
c - Pipe Plug
d - Hex Plug
e - Petcock Location [In Place of Hex Plug (Petcock Not Shown)]

V-8 Closed Cooling Thermostat Housing and Cover

3. Fill Closed Cooling System with coolant mixture through heat exchanger fill neck until coolant appears at opening in thermostat housing or cover (opened or exposed in preceding).
4. Depending on thermostat housing and cover configuration, follow instructions "a" or "b":
   a. **On thermostat housings with pipe plug or hex plug (on housing cover):** Coat threads of pipe plug, or hex plug, with Perfect Seal and reinstall. Tighten securely.
   b. **On thermostat housings with petcock on housing cover:** Close petcock securely.
5. Continue filling Closed Cooling section until coolant level is 1 in. (25 mm) below filler neck.

⚠CAUTION

Avoid seawater pump impeller damage and subsequent overheating damage to engine or stern drive unit. DO NOT operate engine without water being supplied to seawater pickup pump.

⚠CAUTION

Models with belt drive seawater pickup pump must be in the water when running engine because garden hose will not supply enough water to system at higher RPM.

6. With pressure cap off, start engine and run at fast idle (1500-1800 RPM). Add coolant solution to heat exchanger, as required, to maintain coolant level 1 in. (25 mm) below filler neck.
7. After engine has reached normal operating temperature (thermostat is fully open), and coolant level remains constant, fill heat exchanger to bottom of filler neck.
8. Observe engine temperature gauge to make sure that engine operating temperature is normal. If gauge indicates excessive temperature, stop engine immediately and examine for cause.
9. Install pressure cap on heat exchanger.
10. Remove cap from coolant recovery reservoir and fill to "Full" mark with coolant solution. Reinstall cap.
11. With engine still running, check hose connections, fittings and gaskets for leaks. Repeat step 4.

IMPORTANT: Engine overheating is often due to air being trapped in closed cooling section. Purge air by running engine at 2000 RPM for 10 minutes.

⚠WARNING

Allow engine to cool down before removing pressure cap. Sudden loss of pressure could cause hot coolant to boil and discharge violently. After engine has cooled down, turn cap 1/4-turn to allow any pressure to escape slowly, then, push down and turn cap all-the-way off.

12. Recheck coolant level after first open-throttle boat test and add coolant, if necessary.
13. Maintain coolant level in coolant recovery reservoir between "Add" and "Fuli" marks with engine at normal operating temperature.

Cold Weather or Extended Storage

Closed Cooling Section

Closed cooling section of Closed Cooling System should be kept filled year around with recommended coolant solution. Do not drain closed cooling section for storage, as this will promote rusting of internal surfaces. If engine will be exposed to freezing temperatures, make sure that closed cooling section is filled with an ethylene glycol anti-freeze and water solution, mixed to manufacturer's recommended proportion, to protect engine to lowest temperature to which it will be exposed. If necessary, change coolant.

Seawater Section

DRAINING INSTRUCTIONS

⚠CAUTION

Seawater section of cooling system MUST BE COMPLETELY drained for winter storage, or immediately after cold weather use, if the possibility of freezing temperatures exist. Failure to comply may result in trapped water causing freeze and/or corrosion damage to engine.

⚠CAUTION

If boat is in the water, seacock (water inlet valve), if so equipped, must be left closed until engine is to be restarted, to prevent water from flowing back into cooling system and/or boat. If boat is not fitted with a seacock, water inlet hose must be left disconnected and plugged. to prevent water from flowing back into cooling system and/or boat. As a precautionary measure, attach a tag to the ignition switch or steering wheel of the boat with the warning that the seacock must be opened or the water inlet hose reconnected prior to starting the engine.

IMPORTANT: Observe the following information to ensure complete draining of cooling system.

- **Engine must be as level as possible.**
- **A wire should be repeatedly inserted into all drain holes to ensure there are no obstructions in passages.**
- **On later models with two piece petcccks, removal of petcock may be required so that wire can be inserted completely into drain hole.**

IMPORTANT: To prevent threads in manifolds, elbows and cylinder blocks from rusting out during storage, reinstall plugs using Perfect Seal on threads. Never leave drain plugs out during storage.

NOTE: If possible, place a container under drains and hoses to prevent water from draining into boat.

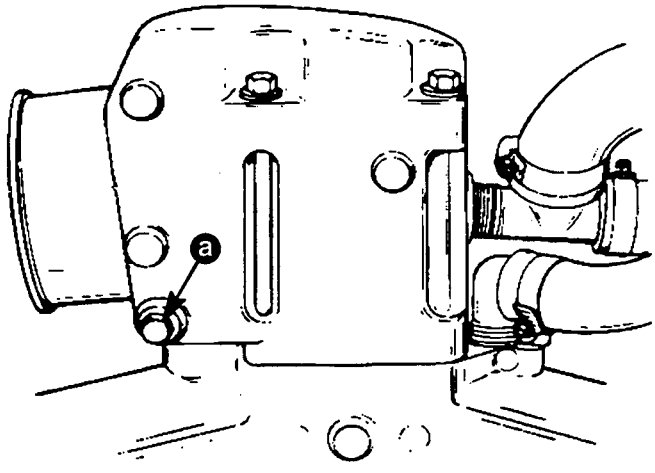
IMPORTANT: Do not use Propylene Glycol Anti-freeze in the closed cooling section of the engine.

MCM/MIE - 305/350 CID Engines (5.0 Litre, 5.0 Litre LX, 5.7 Litre, 350 Magnum, 5.7 Litre Competition Ski and 350 Magnum Tournament Ski Models)

> **NOTICE**
>
> **Refer to "Draining Precautions", in this section, BEFORE proceeding.**

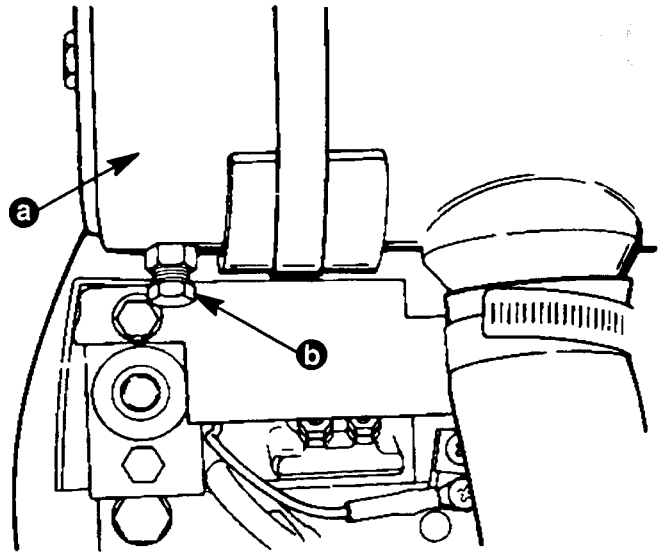
IMPORTANT: 350 Magnum with stainless steel exhaust elbows does not have a drain plug in exhaust elbows.

1. Remove drain plugs, if so equipped, from both exhaust elbows.



a - Drain Plug (If so Equipped)

2. Remove drain plug from heat exchanger.



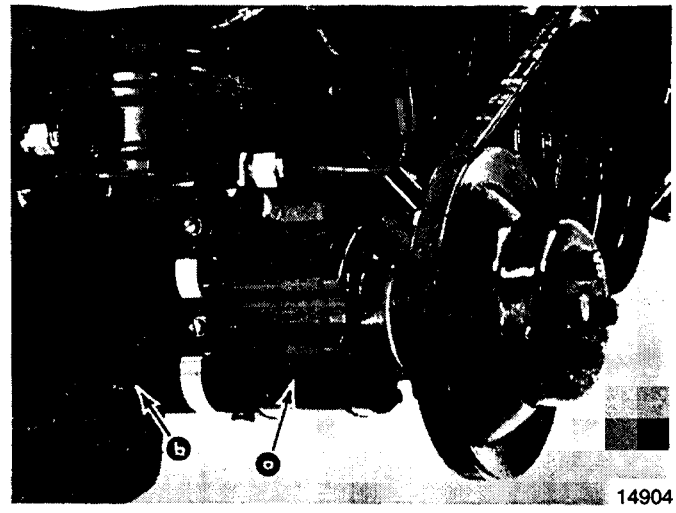
a - Heat Exchanger
b - Drain Plug

Typical Heat Exchanger (All Similar)

3. Repeatedly clean out drain holes using a stiff piece of wire. Do this until entire system is drained.

NOTE: In the following, it may be necessary to lift, bend or lower hoses to allow water to drain completely.

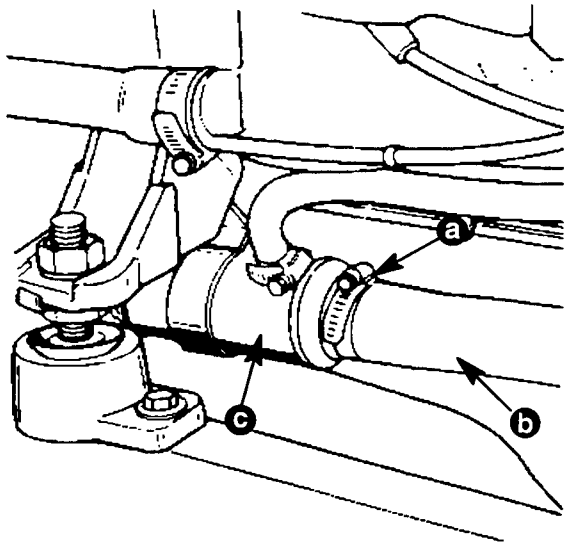
4. Disconnect seawater pump water inlet hose from fitting on seawater pump, as shown. Lower hose and allow to drain.



a - Seawater Pump
b - Seawater Inlet Hose

Seawater Pump

5. Loosen hose clamp and disconnect hose as shown from fluid cooler (**MCM** - power steering fluid cooler, **MIE** - transmission fluid cooler).

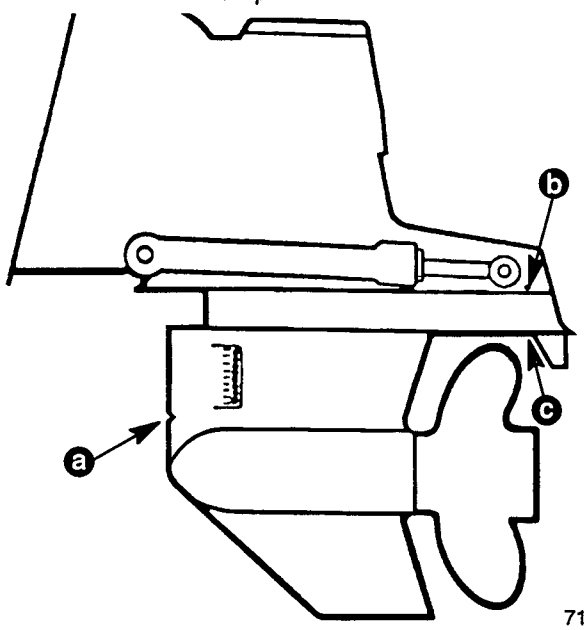


a - Hose Clamp
b - Hose
c - Fluid Cooler (Power Steering Fluid or Transmission Fluid)

6. Follow instructions "a", "b" or "c":

   a. **On MIE (Inboard) Models:** Proceed to next step.

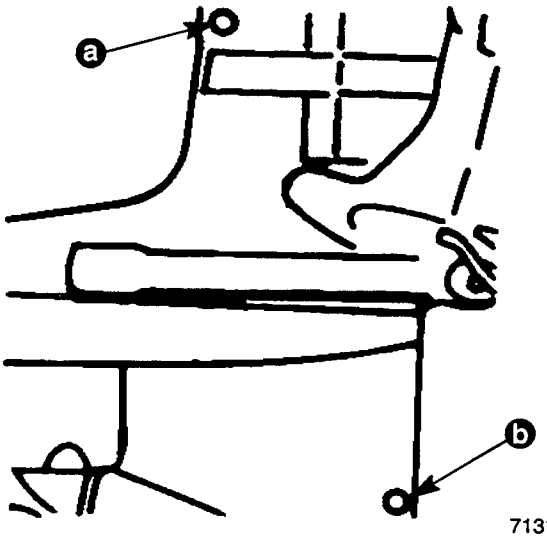
   b. **On Bravo Drive Equipped Models:** Insert a small wire (repeatedly) into openings as shown, to make sure that speedometer pitot tube, trim tab cavity vent hole, and trim tab cavity drain passage are unobstructed and open.



a - Speedometer Pitot Tube
b - Trim Tab Cavity Vent Hole
c - Trim Tab Cavity Drain Passage

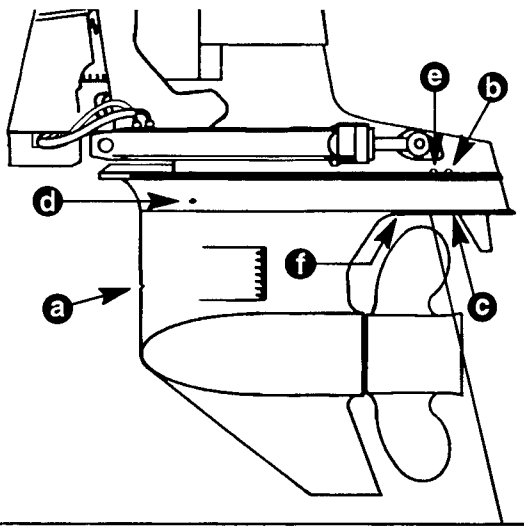
Bravo Drive Unit

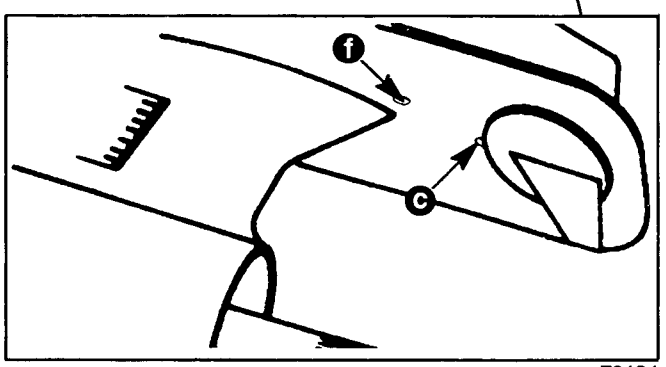
   c. **On Alpha Drive Equipped Models:** Insert a small wire (repeatedly) to make sure that vent holes and water drain holes and passages (as shown) are unobstructed and open.



a - Drive Shaft Housing Water Drain Hole
b - Gear Housing Water Drain Hole

Alpha One Drive Unit

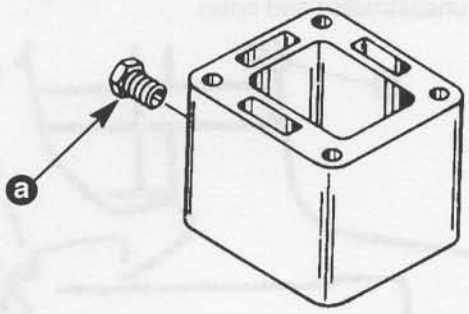




a - Speedometer Pitot Tube
b - Trim Tab Cavity Vent Hole
c - Trim Tab Cavity Drain Passage
d - Gear Housing Water Drain Hole (One Each - Port and Starboard)
e - Gear Housing Cavity Vent Hole
f - Gear Housing Cavty Drain hole

Alpha One Generation II Drive Unit

7. Remove drain plug from port and starboard exhaust elbow risers [3 in. (76 mm) or 6 in. (152 mm)], if so equipped.



a - Drain Plug

Typical Riser Shown

8. Crank engine over SLIGHTLY, with starter motor, to purge any water trapped in seawater pickup pump. DO NOT ALLOW ENGINE TO START.
9. After cooling system has been drained completely, tighten all petcocks securely, coat the threads of all drain plugs with Perfect Seal and reinstall. Tighten drain plugs securely. Reconnect all hoses and tighten all clamps securely.

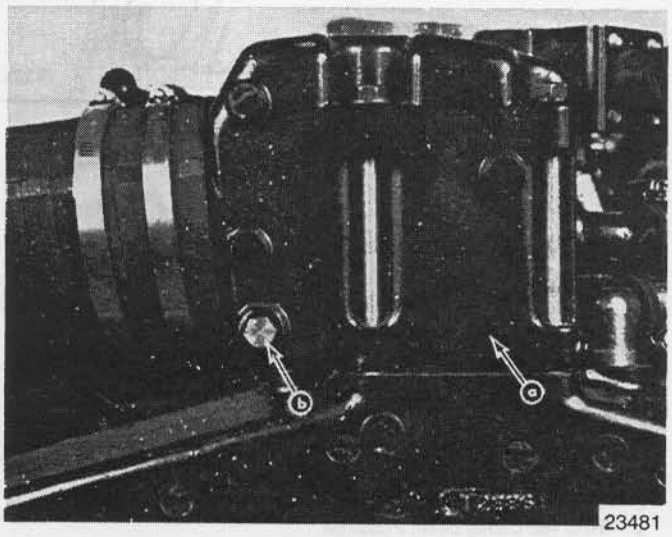
MCM - 454 CID Engines (7.4 Litre and 454 Magnum Models Included)

NOTICE

Refer to "Draining Precautions", in this section, BEFORE proceeding.

1. Remove drain plug, if so equipped, from port and starboard exhaust elbow.

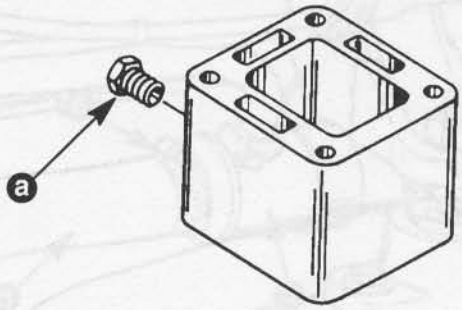
IMPORTANT: If your engine is equipped with stainless steel exhaust elbows, it will not have a drain plug at location shown.



a - Cast Iron Elbow
b - Drain Plug (Not Present on Models with Stainless Steel Exhaust Elbows)

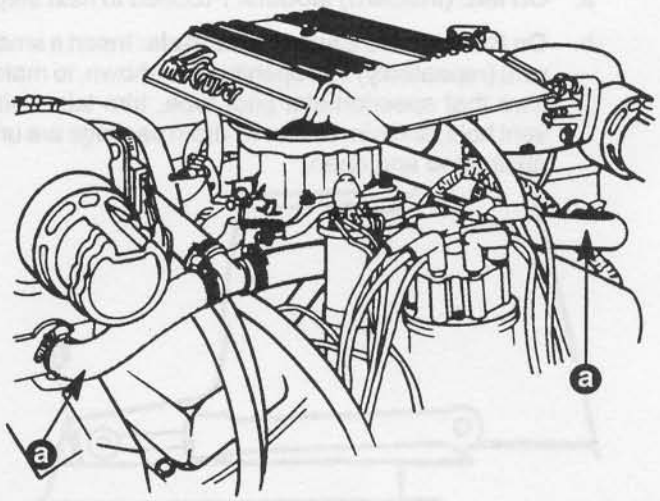
Typical Engine without Risers (Similar with Risers)

2. Follow instructions "a", "b" or "c":
   a. **On Models without Risers:** Proceed to step 3.
   b. **On Models with Cast Iron Exhaust Elbows and Equipped with 3 in. (76 mm) or 6 in. (152 mm) (One-Piece) Exhaust Elbow Risers:** Remove drain plug from each riser (port and starboard).



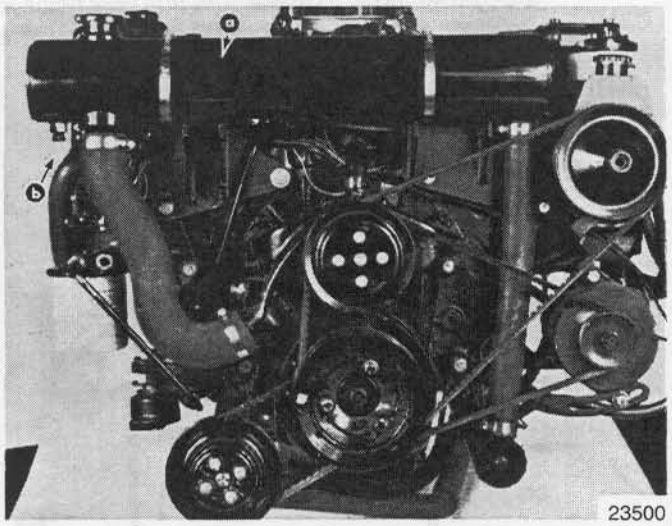
a - Drain Plug (Remove)

   c. **On Models with Stainless Steel Exhaust Elbows and Equipped with 3 in. (76 mm) Exhaust Elbow Risers, or Two 3 in. (76 mm) Risers per Side, to Provide 6 in. (152 mm) Exhaust Elbow Risers:** Remove hose from each straight fitting on exhaust risers (port and starboard).



a - Hose [On Straight Fitting of Riser(s)]

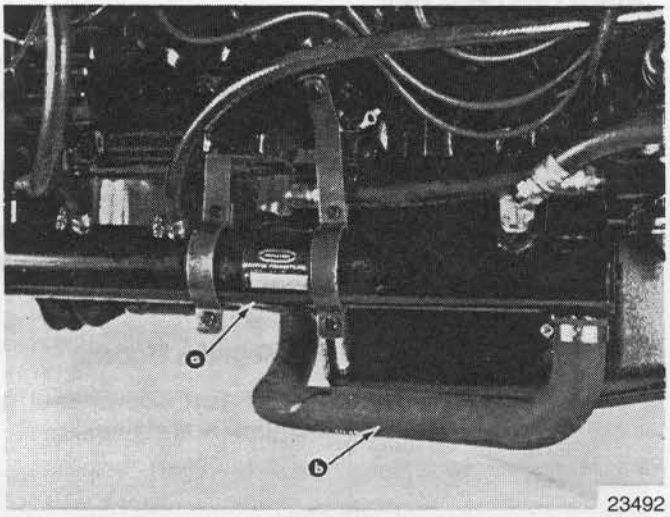
3. Remove drain plug from heat exchanger.



23500

a - Heat Exchanger
b - Drain Plug

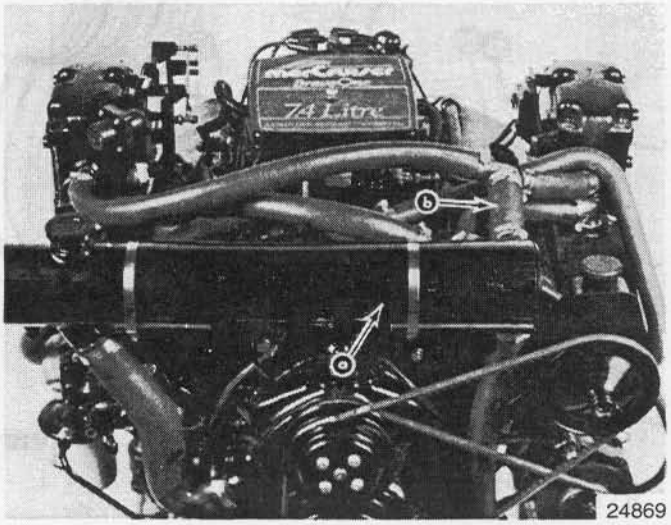
4. Disconnect hose from oil cooler. Lower hose and allow to drain. Reconnect hose and tighten securely.



23492

a - Oil Cooler
b - Seawater Pump-to-Oil Cooler Hose

5. Disconnect heat exchanger-to-"T" fitting hose from heat exchanger. Lower hose to allow water to drain.

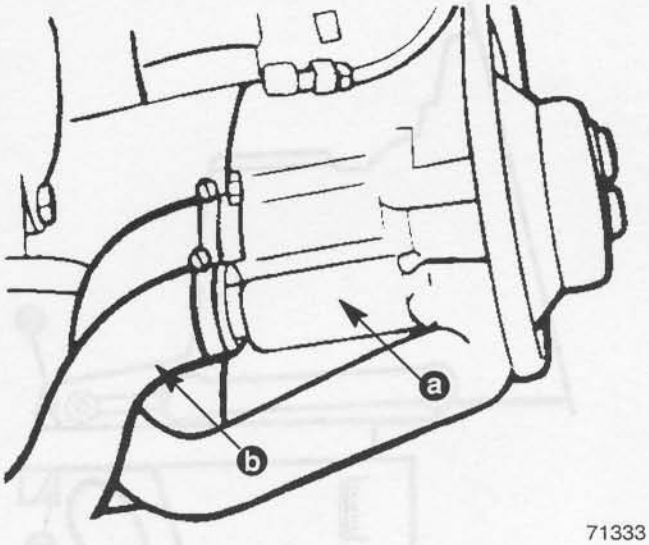


24869

a - Heat Exchanger
b - Heat Exchanger-to-"T" Fitting Hose

Typical Engine without Risers (Similar with Risers)

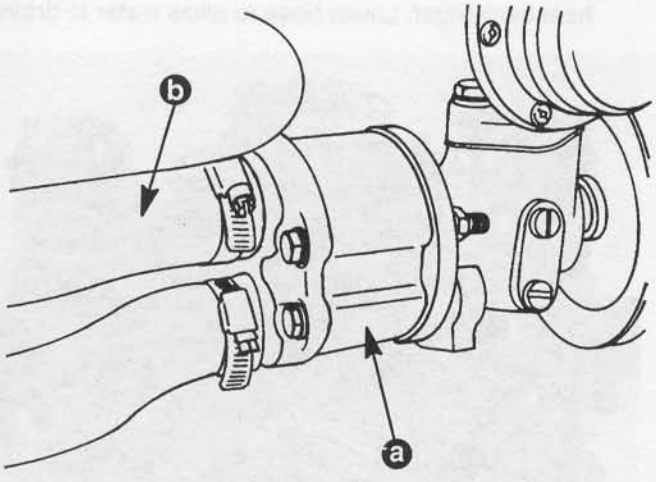
6. Disconnect seawater pump water inlet hose from fitting on seawater pump as shown. Lower hose and allow to drain.



71333

a - Seawater Pump
b - Seawater Inlet Hose

Seawater Pump Without Combination Fuel Pump

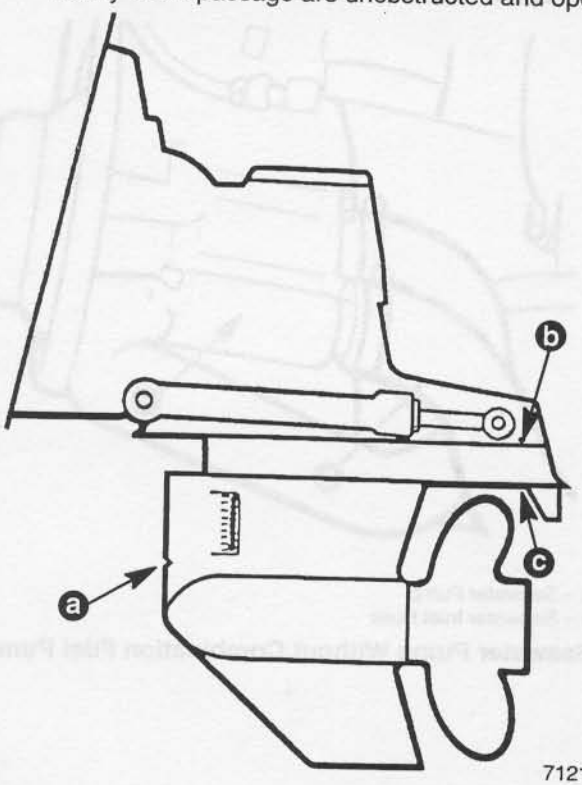


71170

a - Seawater Pump
b - Seawater Inlet Hose

Seawater Pump With Combination Fuel Pump

7. Follow instructions "a" or "b":
   a. **On Bravo Drive Equipped Models:** Insert a small wire (repeatedly) to make sure that speedometer pitot tube, trim tab cavity vent hole, and trim tab cavity drain passage are unobstructed and open.

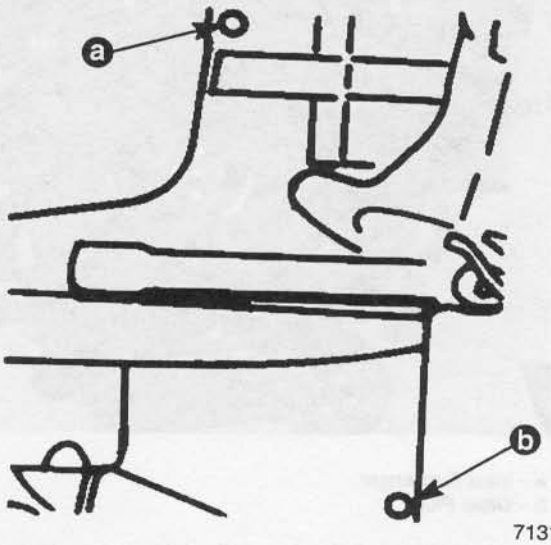


71217

a - Speedometer Pitot Tube
b - Trim Tab Cavity Vent Hole
c - Trim Tab Cavity Drain Passage

Bravo Drive Unit

   b. **On Alpha Drive Equipped Models:** Insert a small wire (repeatedly) to make sure that vent holes and water drain holes and passages (as shown) are unobstructed and open.



71316

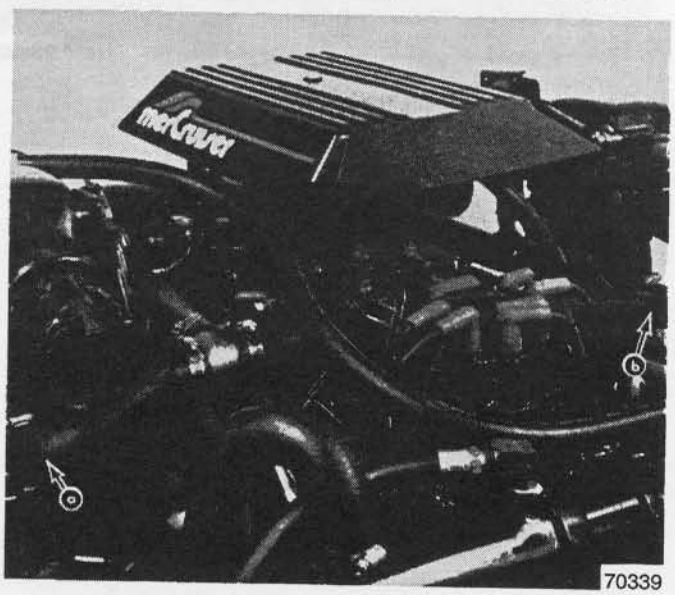
a - Drive Shaft Housing Water Drain Hole
b - Gear Housing Water Drain Hole

Alpha One Drive Unit

8. Crank engine over SLIGHTLY, with starter motor, to purge any water trapped in seawater pickup pump. DO NOT ALLOW ENGINE TO START.
9. After cooling system has been drained completely, tighten all petcocks securely, coat the threads of all drain plugs with Perfect Seal and reinstall. Tighten drain plugs securely. Reconnect all hoses and tighten all clamps securely.

MCM - 502 CID Engines (502 Magnum Models)

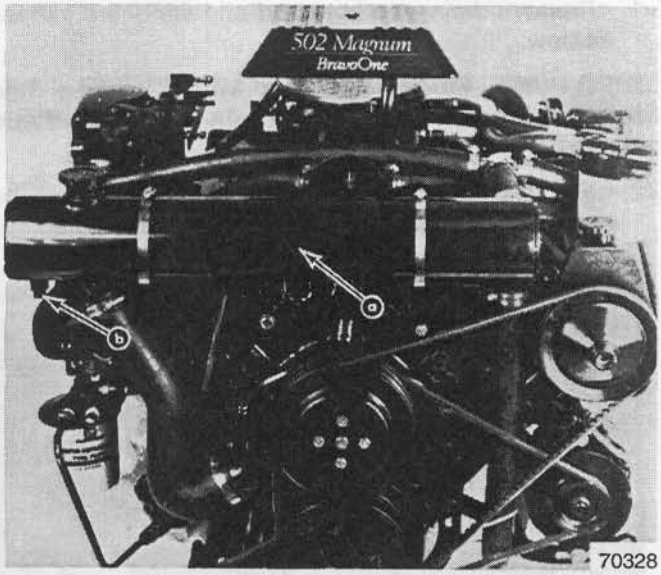
1. If engine is equipped with exhaust elbow risers, remove hose from each riser (port and starboard).



70339

a - Hose – To Port Exhaust Riser
b - Hose – To Starboard Exhaust Riser

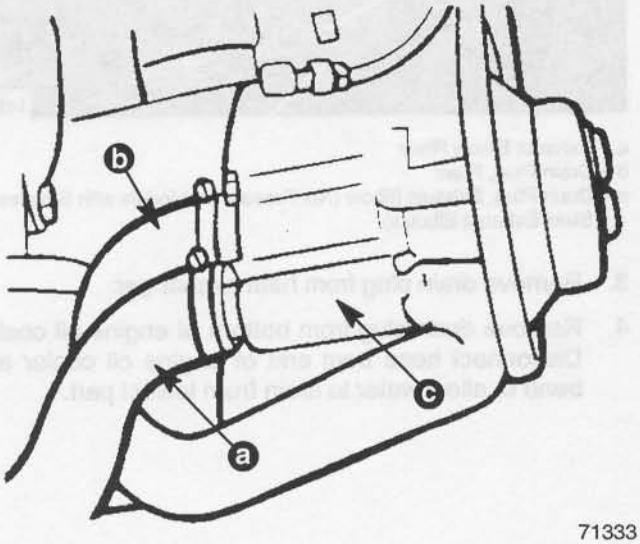
2. Remove drain plug from heat exchanger.



70328

a - Heat Exchanger
b - Drain Plug

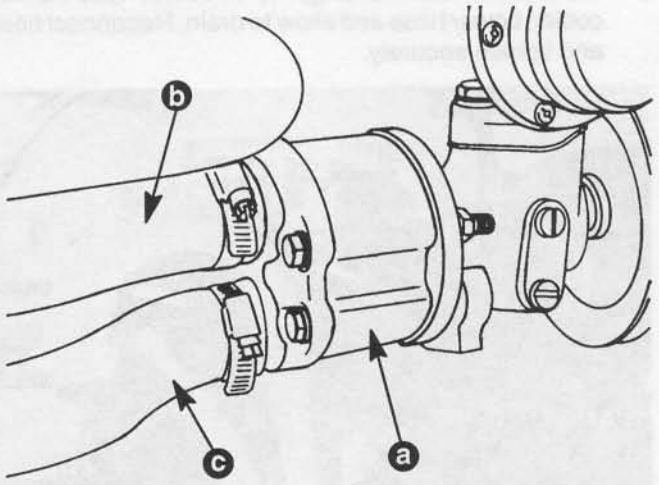
3. Disconnect seawater pump water inlet hose from fitting on seawater pump as shown. Lower hose and allow to drain.



71333

a - Seawater Inlet Hose
b - Hose to Oil Cooler
c - Seawater Pump

Seawater Pump Without Combination Fuel Pump



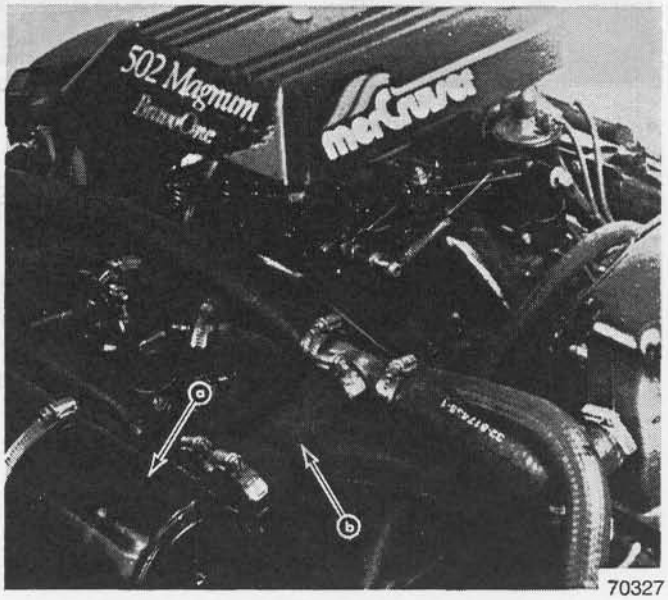
71170

a - Seawater Pump
b - Seawater Inlet Hose
c - Hose to Oil and Power Steering Fluid Cooler

Seawater Pump With Combination Fuel Pump

4. Disconnect heat exchanger-to-"T"-Fitting hose from heat exchanger. Lower hose to allow water to drain.

NOTE: Remote oil filter is not shown on port exhaust elbow, for visual clarity.

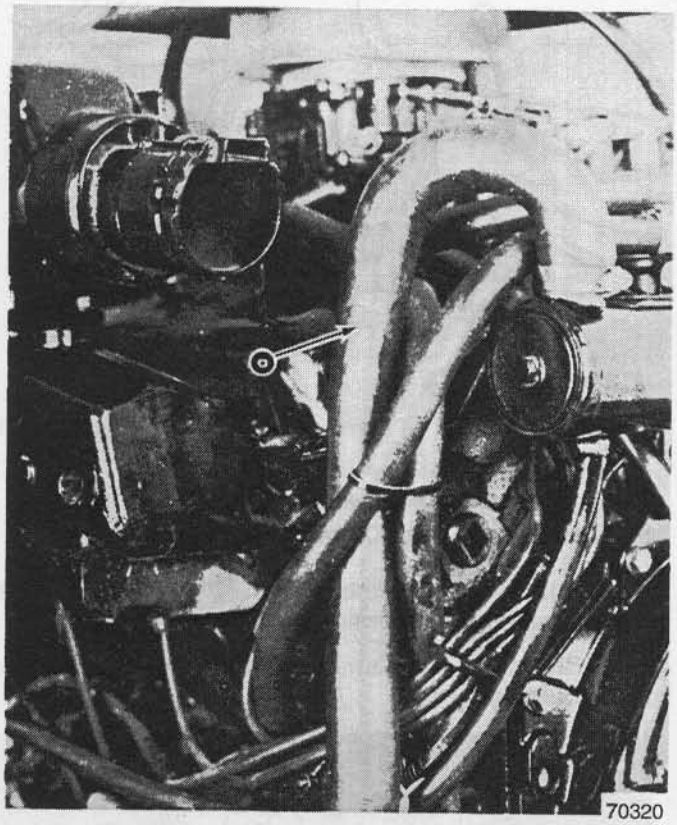


70327

a - Heat Exchanger
b - Heat Exchanger-to-"T"-Fitting Hose

Shown Without Risers (Models With Risers Similar)

5. Disconnect heat exchanger-to-oil cooler hose from oil cooler. Lower hose and allow to drain. Reconnect hose and tighten securely.



a - Hose from Heat Exchanger

6. Crank engine over SLIGHTLY, with starter motor, to purge any water trapped in seawater pickup pump. DO NOT ALLOW ENGINE TO START.

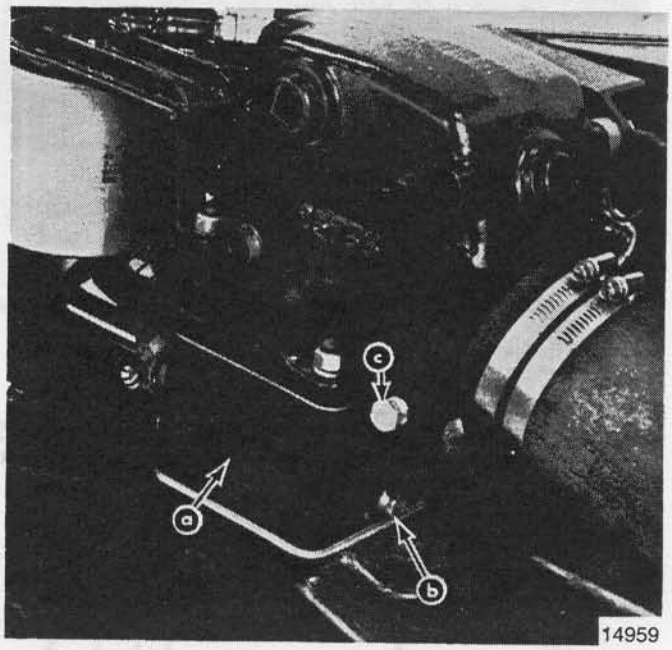
7. After cooling system has been drained completely, tighten all petcocks securely, coat the threads of all drain plugs with Perfect Seal and reinstall. Tighten drain plugs securely. Reconnect all hoses and tighten all clamps securely.

MIE - 454 CID Engines (7.4 Litre Models)

1. Remove drain plug from port and starboard exhaust elbow.

IMPORTANT: Models equipped with Stainless Steel Exhaust Elbows do not have drain plugs on exhaust elbows.

2. If engine is equipped with exhaust elbow risers, remove drain plug from each riser (port and starboard).

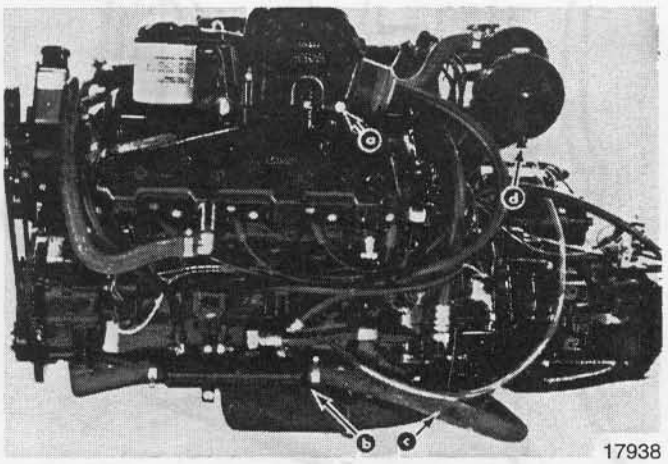


a - Exhaust Elbow Riser
b - Drain Plug, Riser
c - Drain Plug, Exhaust Elbow (Not Present on Models with Stainless Steel Exhaust Elbows)

3. Remove drain plug from heat exchanger.

4. Remove drain plug from bottom of engine oil cooler. Disconnect hose from end of engine oil cooler and bend to allow water to drain from lowest part.

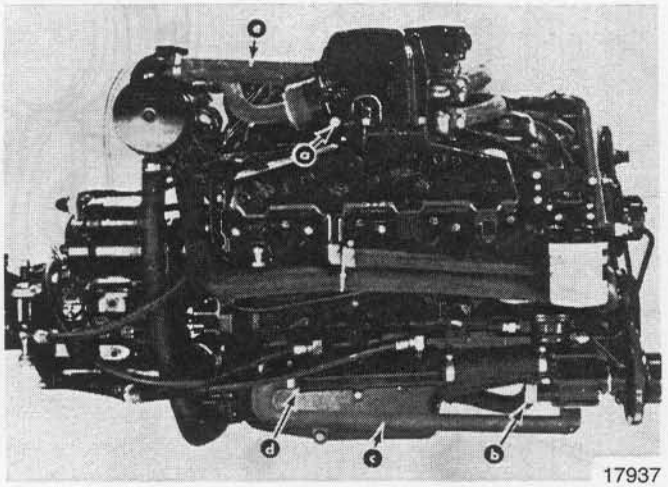
5. Remove drain plug from bottom of transmission fluid cooler. Disconnect hose from end of transmission fluid cooler and bend to allow water to drain from lowest part.



17938

a - Exhaust Elbow Drain Plug (Not Present on Models with Stainless Steel Exhaust Elbows)
b - Engine Oil Cooler Drain Plug
c - Engine Oil Cooler-to-Heat Exchanger Hose
d - Heat Exchanger Drain Plug

Port Side - Engines with Borg-Warner In-Line Transmissions

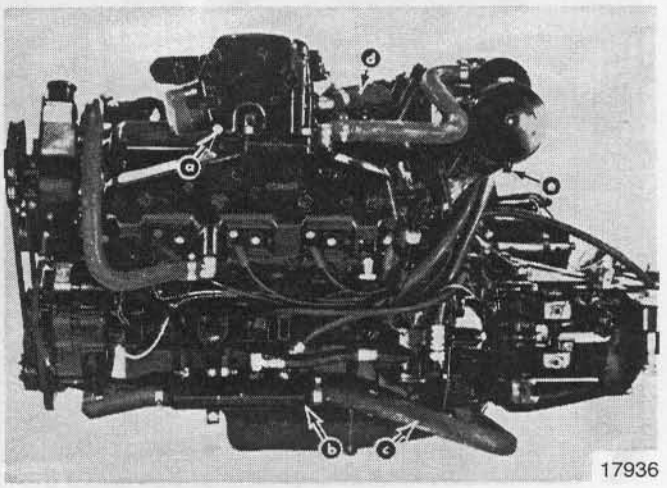


17937

a - Exhaust Elbow Drain Plug (Not Present on Models with Stainless Steel Exhaust Elbows)
b - Water Inlet Hose (Not Shown)
c - Transmission Fluid Cooler-to-Engine Oil Cooler Hose
d - Transmission Fluid Cooler Drain Plug
e - Heat Exchanger-to-"T"-Fitting Hose

Starboard Side - Engines with Borg-Warner In-Line Transmissions

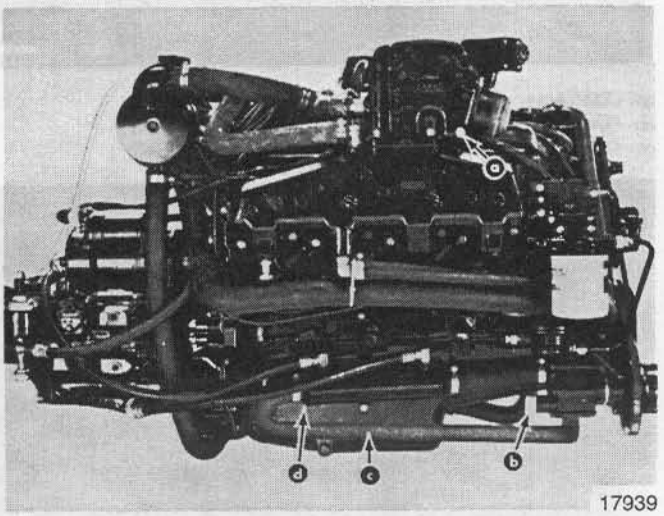
6. If engine will be restarted during freezing temperature period, proceed as follows:
   a. Disconnect heat exchanger-to-"T"-fitting hose from heat exchanger and bend hose to allow water to drain from lowest part.



17936

a - Exhaust Elbow Drain Plug (Not Present on Models with Stainless Steel Exhaust Elbows)
b - Engine Oil Cooler Drain Plug
c - Engine Oil Cooler-to-Heat Exchanger Hose
d - "T"-Fitting-to-Port Exhaust Elbow Hose
e - Heat Exchanger Drain Plug

With V-Drive Transmission - Port Side

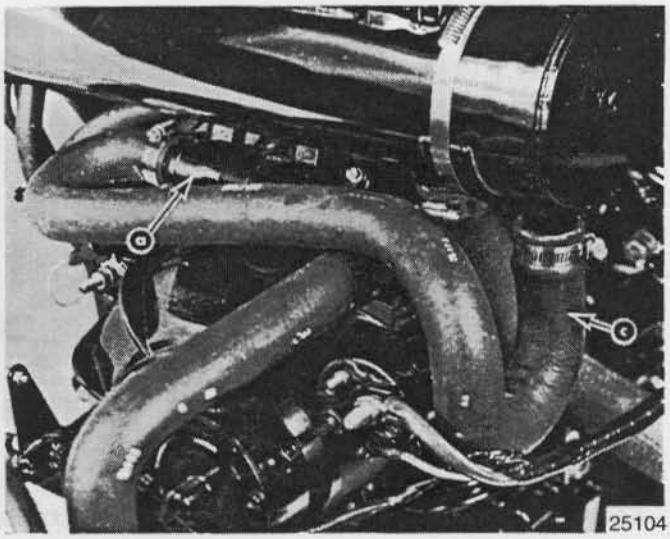


17939

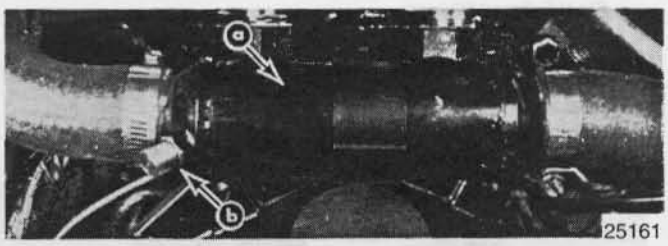
a - Exhaust Elbow Drain Plug (Not Present on Models with Stainless Steel Exhaust Elbows)
b - Water Inlet Hose (Not Shown)
c - Transmission Fluid Cooler-to-Engine Oil Cooler Hose
d - Transmission Fluid Cooler Drain Plug

With V-Drive Transmission - Starboard Side

NOTE: Draining locations on engines with Hurth transmission are similar to those on engines with Borg-Warner transmission, with exception of the oil cooler and transmission cooler location. (Shown following.)

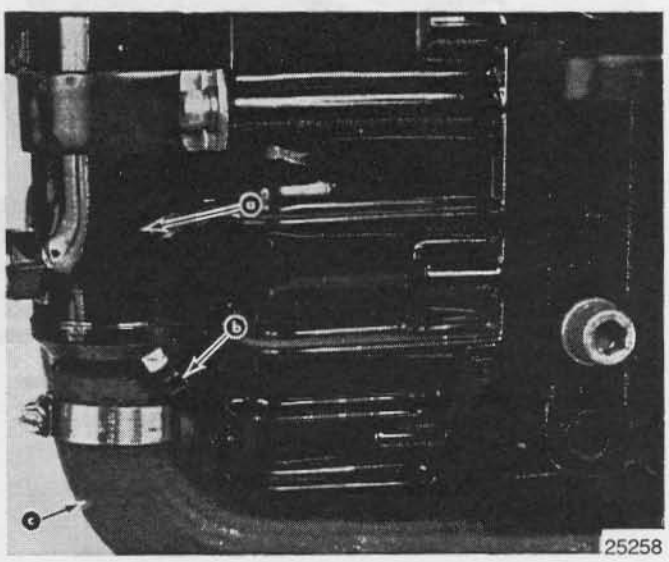


25104



25161

a - Oil Cooler
b - Drain Plug
c - Hose - Remove and Lower to Drain

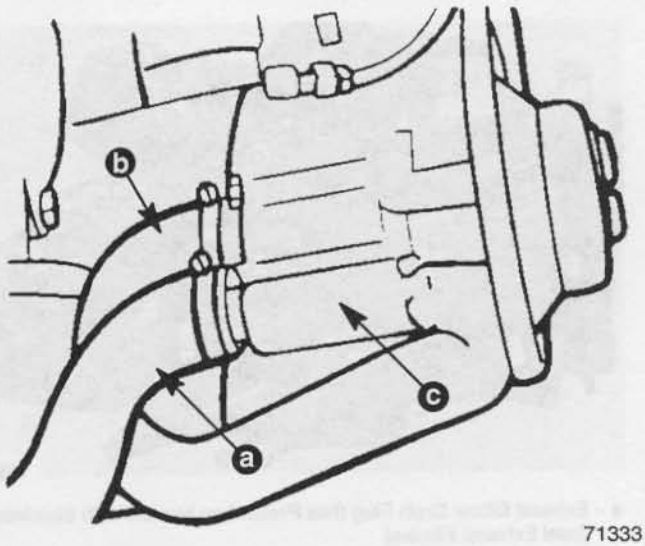


25258

a - Transmission Cooler
b - Drain Plug
c - Lower - Remove and Lower to Drain

Engines with Hurth Transmission

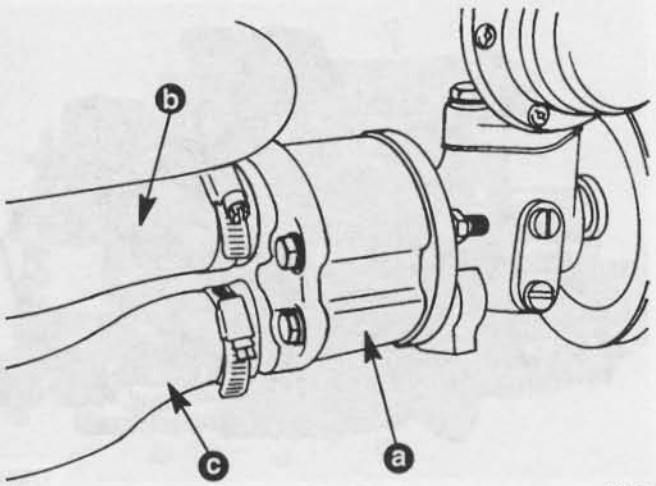
7. Disconnect seawater pump water inlet hose from fitting on seawater pump as shown. Lower hose and allow to drain.



71333

a - Seawater Inlet Hose
b - Hose to Transmission Fluid Cooler
c - Seawater Pump

Seawater Pump Without Combination Fuel Pump



71170

a - Seawater Pump
b - Seawater Inlet Hose
c - Hose to Transmission Fluid Cooler

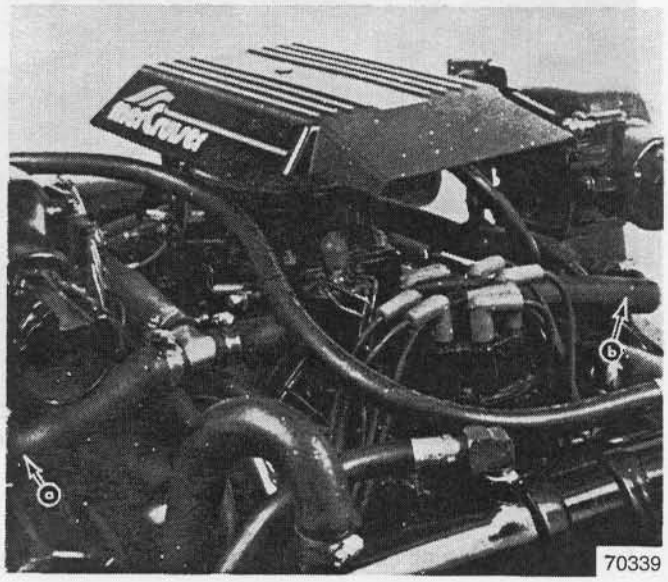
Seawater Pump With Combination Fuel Pump

8. Crank engine over SLIGHTLY, with starter motor, to purge any water trapped in seawater pickup pump. DO NOT ALLOW ENGINE TO START.

9. After cooling system has been drained completely, tighten all petcocks securely, coat the threads of all drain plugs with Perfect Seal and reinstall. Tighten drain plugs securely. Reconnect all hoses and tighten all clamps securely.

MIE - 502 CID Engines (8.2 Litre Models)

1. If engine is equipped with exhaust elbow risers, remove hose from each riser (port and starboard).

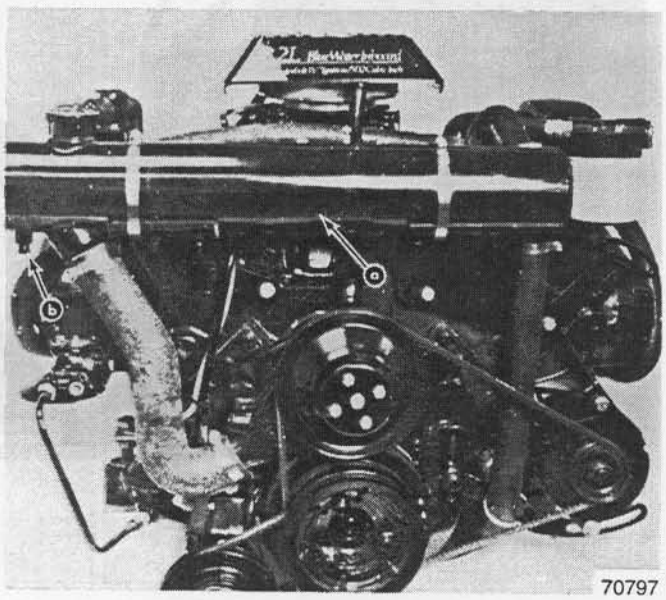


70339

a - Hose – To Port Exhaust Riser
b - Hose – To Starboard Exhaust Riser

Typical Engine Shown With 3 in. (76mm) Risers [6 in. (152mm) Similar]

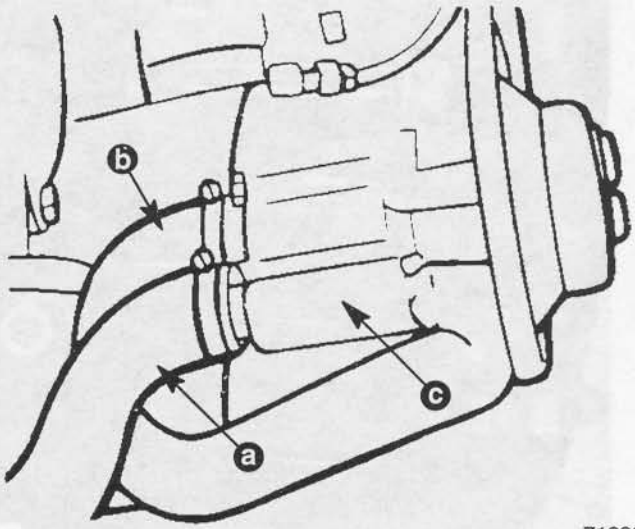
2. Remove drain plug from heat exchanger.



70797

a - Heat Exchanger
b - Drain Plug

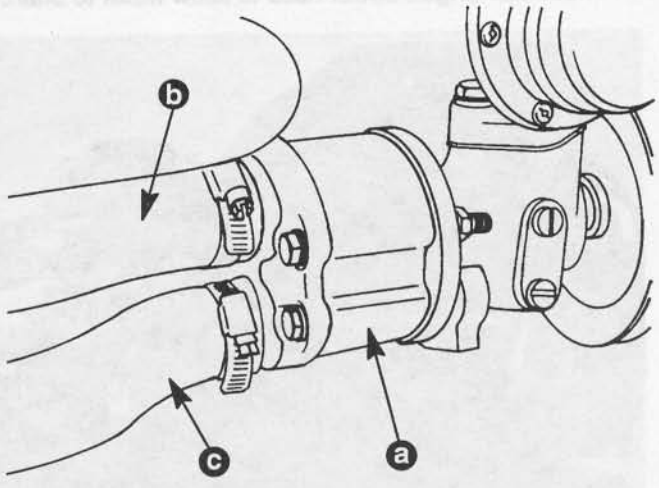
3. Disconnect seawater pump water inlet hose from fitting on seawater pump as shown. Lower hose and allow to drain.



71333

a - Seawater Inlet Hose
b - Hose to Transmission Fluid Cooler
c - Seawater Pump

Seawater Pump Without Combination Fuel Pump

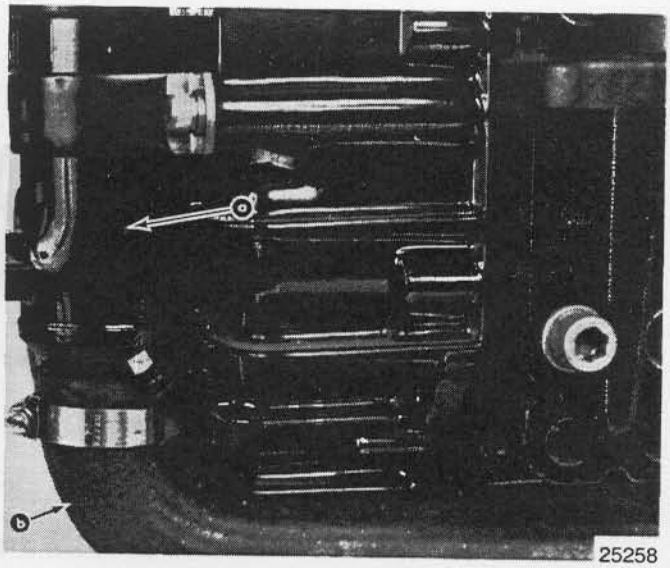


71170

a - Seawater Pump
b - Seawater Inlet Hose
c - Hose to Transmission Fluid Cooler

Seawater Pump With Combination Fuel Pump

4. Disconnect seawater pump hose from end of transmission fluid cooler and bend to allow water to drain from lowest part.



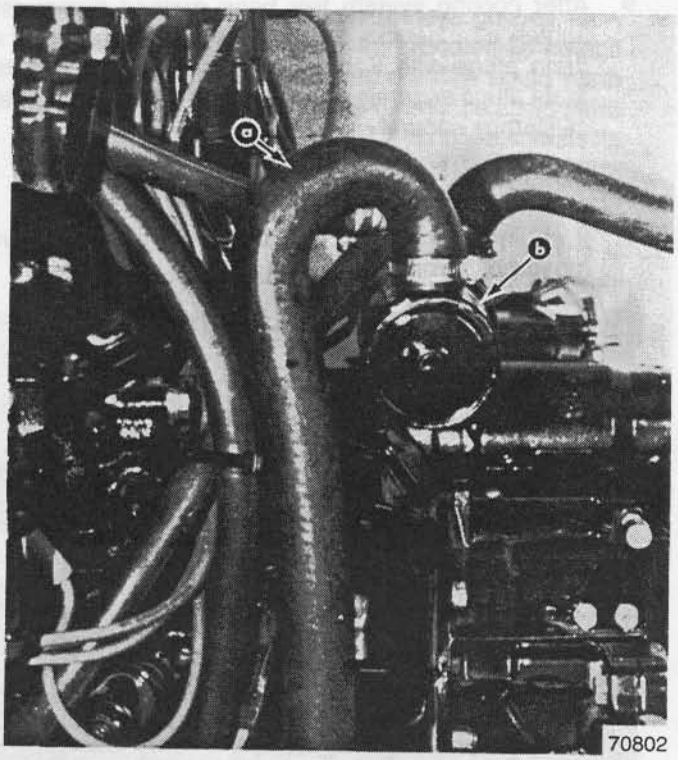
a - Transmission Cooler
b - Lower Hose (From Seawater Pump)

5. Disconnect heat exchanger-to-"T"-Fitting hose from heat exchanger. Lower hose to allow water to drain.

a - Heat Exchanger
b - "T"-Fitting
c - Heat Exchanger-to-"T"-Fitting Hose

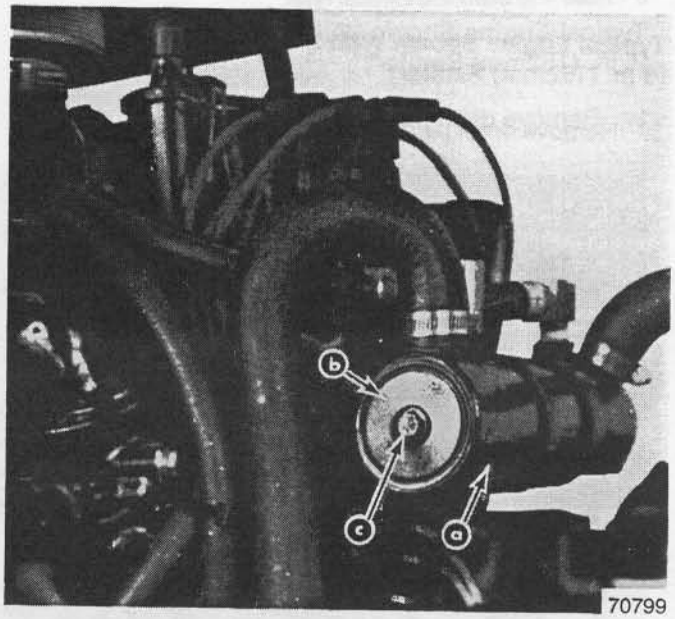
Shown Without Risers (Models With Risers Similar)

6. Disconnect heat exchanger-to-oil cooler hose from oil cooler. Lower hose and allow to drain. Reconnect hose and tighten hose clamp securely.



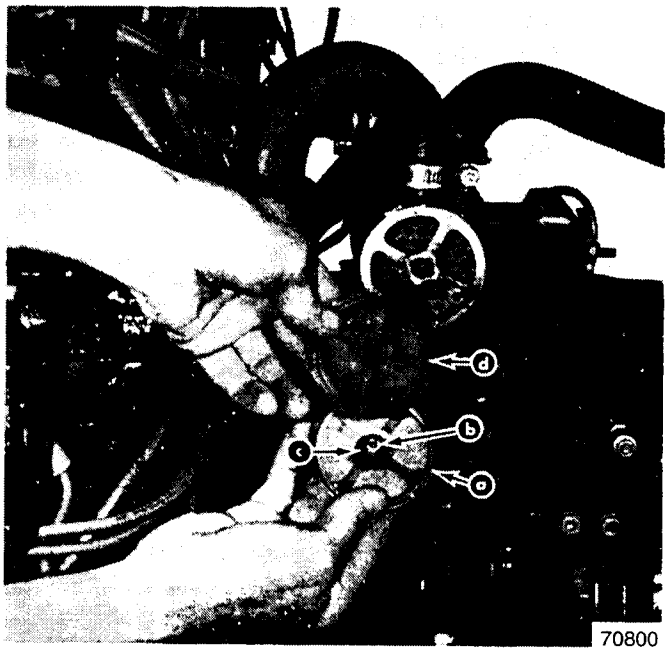
a - Hose from Heat Exchanger
b - Oil Cooler

7. Drain engine oil cooler following instructions "a" - "c":
   a. Remove end cover attaching screw.



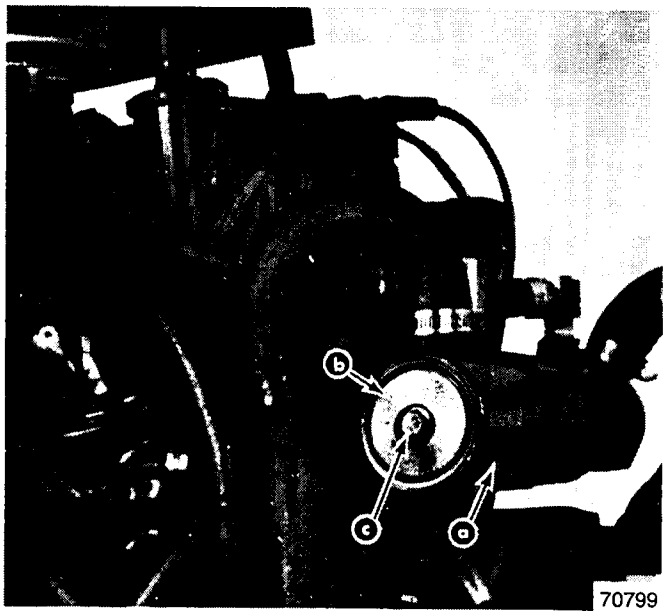
a - Engine Oil Cooler
b - End Cover
c - Screw

b. Remove end cover, O-ring and rubber gasket from engine oil cooler. Allow to drain.



a - End Cover
b - Screw
c - O-ring
d - Rubber Gasket

c. Clean gasket mating surfaces on end cover and oil cooler. Inspect gasket and O-ring for damage and replace if necessary. Reinstall end cover with components in order of removal. Torque end cover attaching screw to 1 to 1-1/2 turns past hand-tight.



a - Engine Oil Cooler
b - End Cover
c - Screw

8. Crank engine over SLIGHTLY, with starter motor, to purge any water trapped in seawater pickup pump. DO NOT ALLOW ENGINE TO START.
9. After cooling system has been drained completely, tighten all petcocks securely, coat the threads of all drain plugs with Perfect Seal and reinstall. Tighten drain plugs securely. Reconnect all hoses and tighten all clamps securely.

Auxiliary Hot Water Heater Installation

IMPORTANT: When connecting a cabin heater or hot water heater, certain requirements must be met.

- **Supply hose (from engine to heater) and return hose (from heater to engine) MUST NOT EXCEED 5/8 inch (15.8mm) I.D. (inside diameter).**
- **Engine equipped with a closed cooling system: Heater MUST BE LOWER than fill cap on the heat exchanger. If the heater is higher than the fill cap on the heat exchanger and some coolant is lost in the system, an air pocket may form in the closed cooling system. This, in turn, can cause the engine to overheat.**
- **Make heater connections ONLY at locations described in the following instructions.**
- **Check complete system for leaks after heater is connected into cooling system.**
- **Check for overheating condition (of engine) after heater is connected.**

1. Refer to Changing Coolant - "Draining Precautions" and "Draining Instructions," and drain closed cooling system.
2. Inspect for appropriate location of supply hose at following:

NOTE: Hot water heater supply hose can be connected at several different locations. On some models, there may be other accessories and options that are utilizing these hot water supply locations. One of the following should be available for use when installing a hot water heater system.

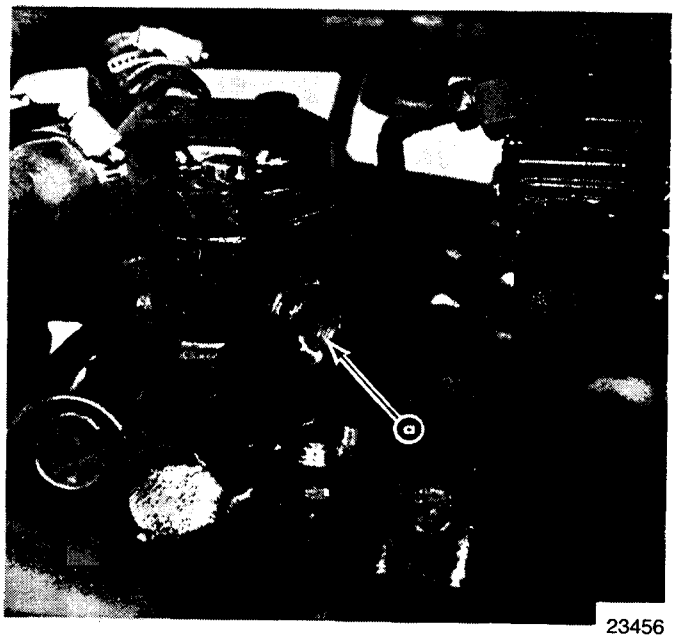
a. Port side of thermostat housing.

NOTE: On some models it may be necessary to remove the Audio Warning Heat Switch from port side of thermostat housing and reposition to water circulating pump opening as outlined following.

b. Starboard side of thermostat housing, unless being utilized for engine temperature switch.

IMPORTANT: Do not reposition engine temperature switch, it must remain where installed by factory.

c. Intake manifold near thermostat housing (some models).



Thermostat Housing - Port Side Shown (Starboard Similar)

Intake Manifold - (If Engine Temperature Sender is Not Installed at This Location) (Except 1988 and Newer 350 Magnum)

3. Connect hot water heater SUPPLY hose to desired location following instructions "a" or "b":

   a. **On Models with Pipe Plug, in Thermostat Housing (port or starboard) or Intake Manifold:**

      (1) Remove pipe plug.

      (2) Coat threads of fitting(s) (obtained locally) with Perfect Seal and install fitting(s) in threaded hole from which pipe plug was removed.

      (3) Connect hot water heater supply hose to fitting and secure with a hose clamp (not provided).

   b. **On Models with Audio Warning Heat Switch in Thermostat Housing (Port Side):**

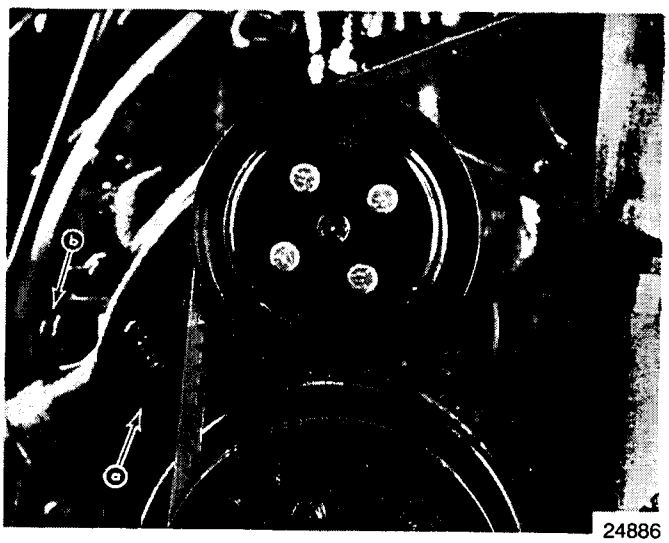
      (1) Disconnect Tan/Blue wire from audio warning switch.

      (2) Remove audio warning switch from thermostat housing.

      (3) Coat threads of fitting(s) (obtained locally) with Perfect Seal and install fitting(s) in threaded hole from which pipe plug was removed.

      (4) Connect hot water heater supply hose to fitting and secure with a hose clamp (not provided).

      (5) Remove pipe plug from starboard side of engine water circulating pump.



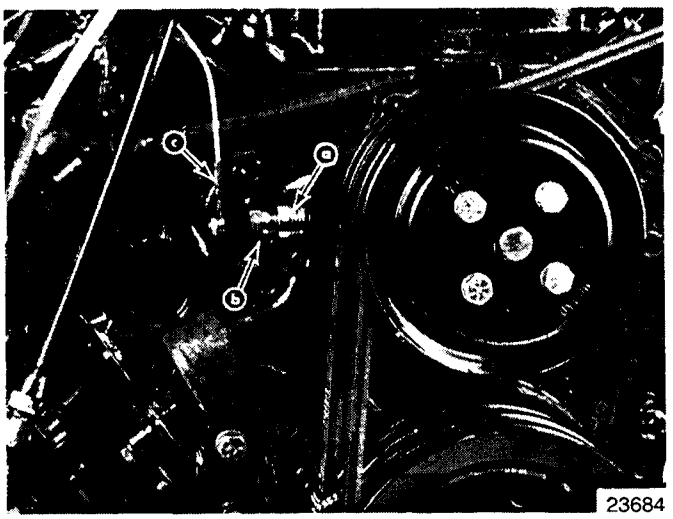
a - Engine Water Circulating Pump
b - Pipe Plug

(6) Apply Loctite Pipe Sealant (with teflon) to threads of reducer bushing (obtain locally) and audio warning heat switch.

(7) Install reducer bushing in circulating pump and tighten securely.

(8) Install audio warning switch in reducer bushing and tighten securely.

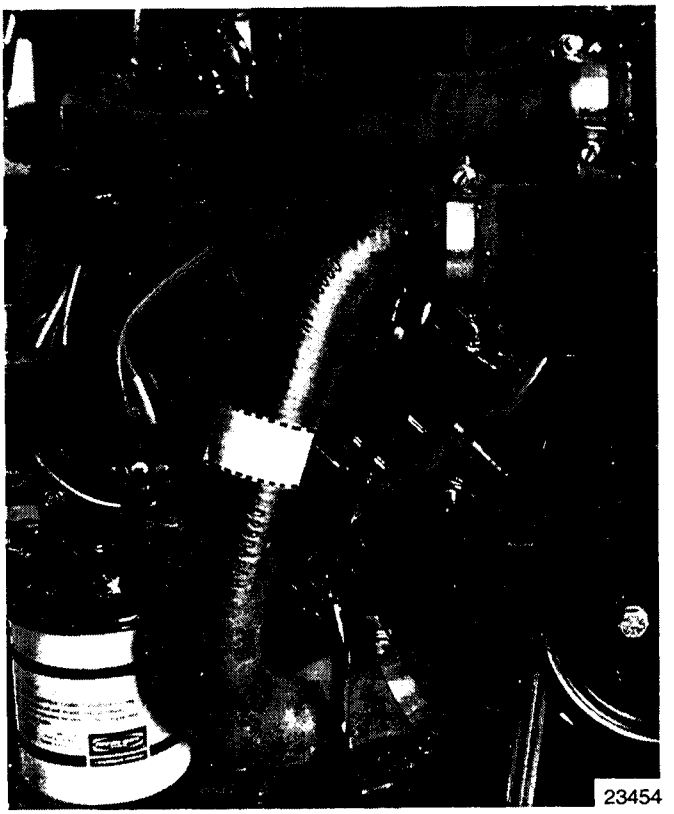
(9) Connect Tan/Blue wire to switch and secure with nut and lockwasher. Coat terminal with Liquid Neoprene.

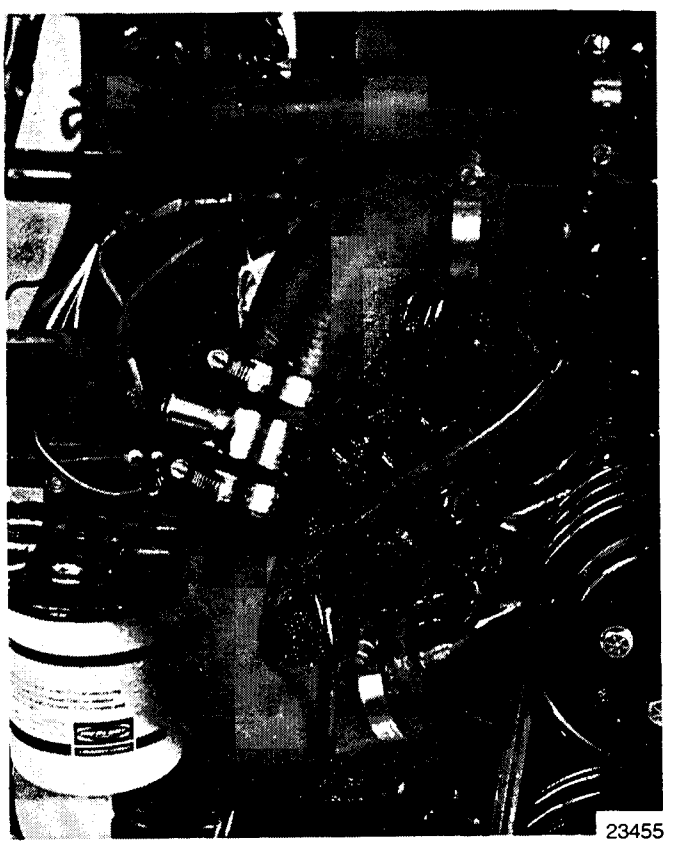


23684

a - Reducer Bushing
b - Audio Warning Heat Switch
c - Tan/Blue Wire

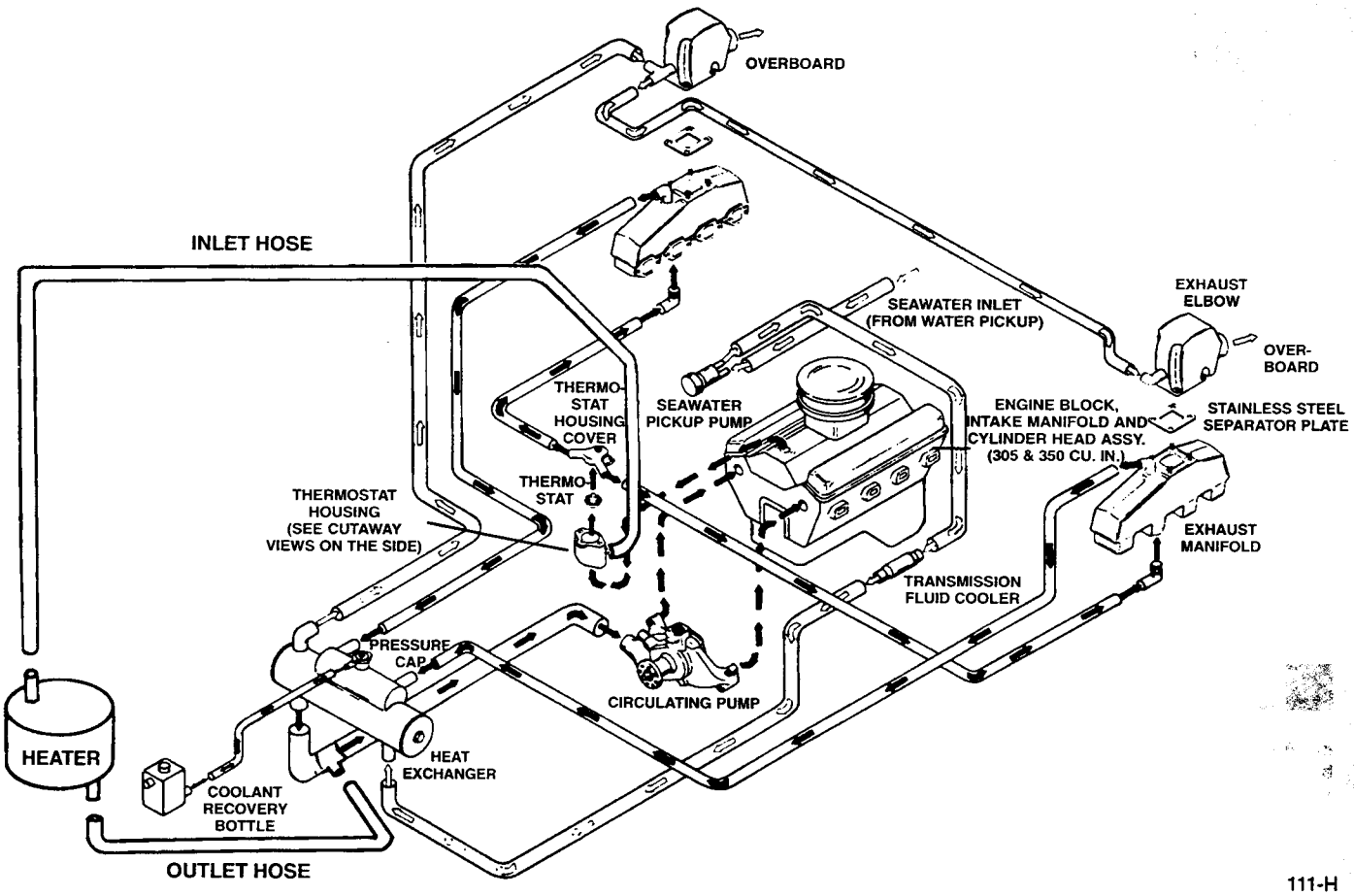
4. Connect hot water heater return hose into system as follows (refer to figures):
   a. Cut approximately 3/4 inch (19mm) out of hose to maintain proper hose configuration.
   b. Secure "T"-fitting in hose with hose clamps (provided in kit) and tighten securely.
   c. Connect hot water heater return hose to "T"-fitting and secure with hose clamp (provided).
5. Secure hoses, as required, to ensure they do not rub or chafe against engine components.
6. With boat in water, start engine and check for leaks and overheating.


23454


23455

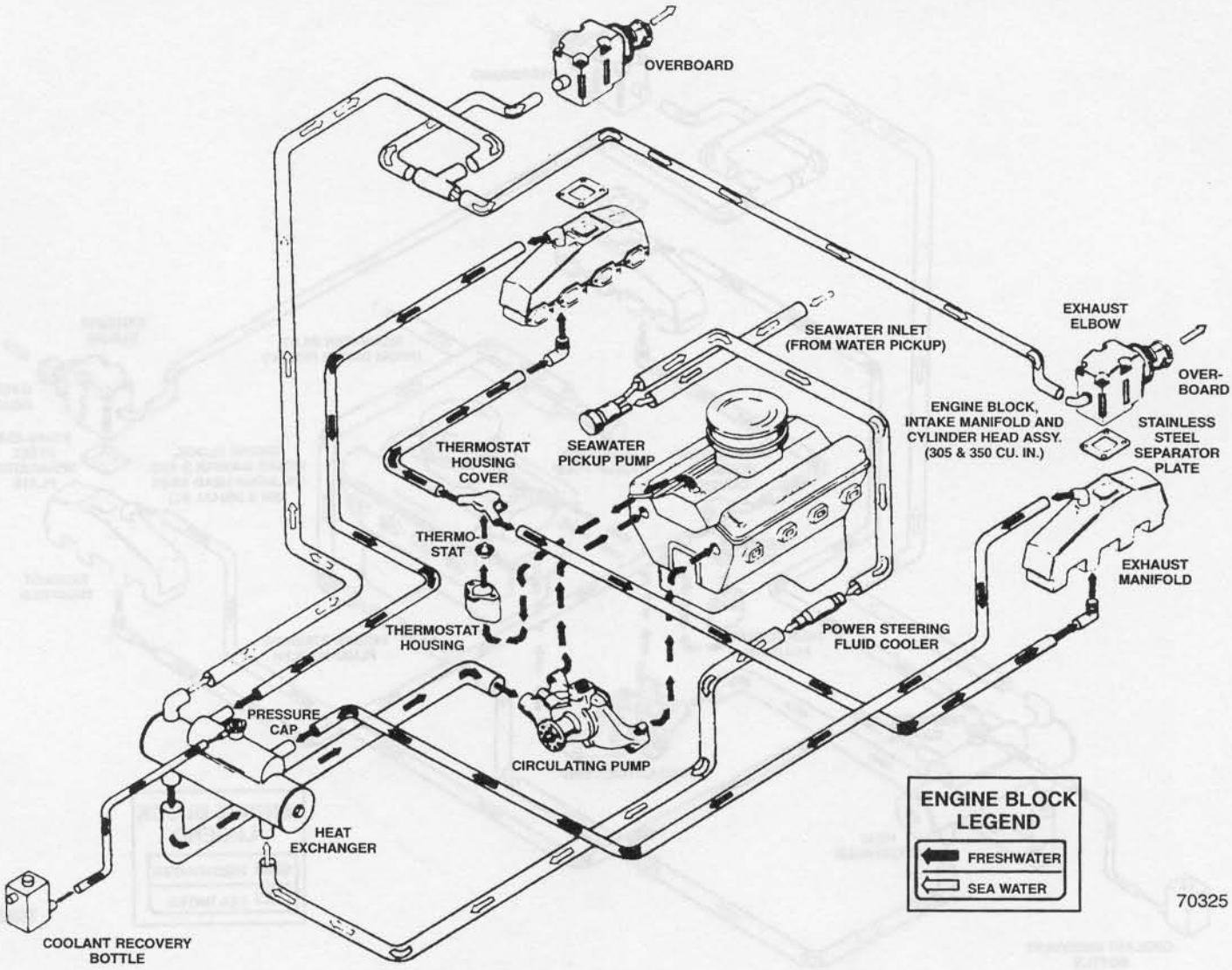
NOTE: See following page for Flow Diagram – "Heater Connection on Typical MerCruiser V-8 (GM) Engine with Closed Cooling System."

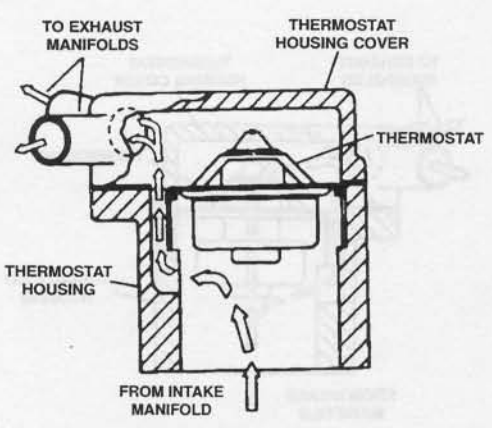
Flow Diagram - Heater Connection



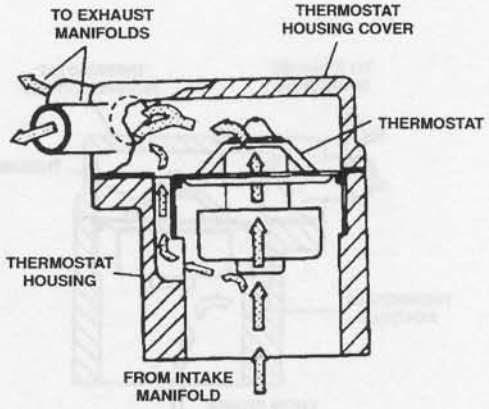
Heater Connection/Flow Diagram on Typical MerCruiser V-8 (GM) Engine with Closed Cooling System

Front Mounted Closed Cooling System Flow Diagram





COOLANT FLOW THROUGH THERMOSTAT HOUSING WITH THERMOSTAT CLOSED (ENGINE COLD)

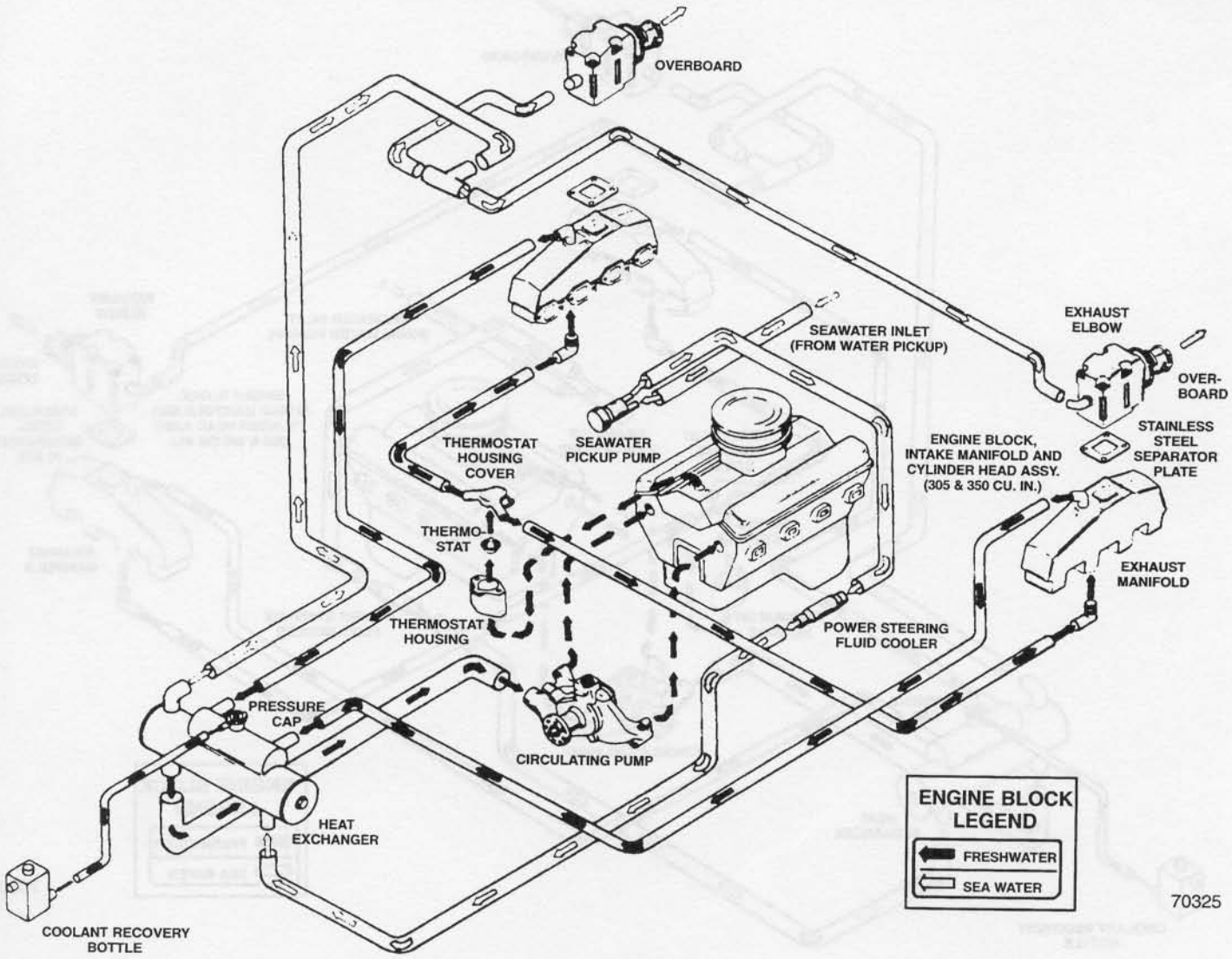


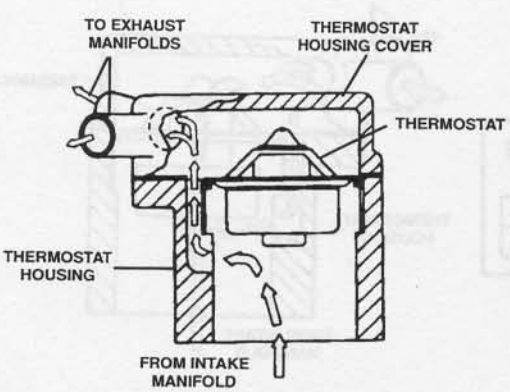
779-H1

COOLANT FLOW THROUGH THERMOSTAT HOUSING WITH THERMOSTAT OPEN (ENGINE WARM)

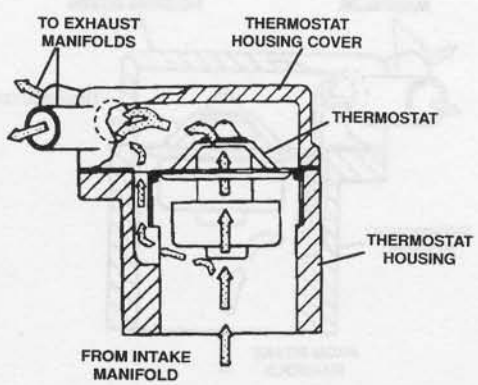
MCM - 5.0 Litre, 5.0 Litre LX, 5.7 Litre, 350 Magnum (Alpha One)

Front Mounted Closed Cooling System Flow Diagram





COOLANT FLOW THROUGH THERMOSTAT HOUSING WITH THERMOSTAT CLOSED (ENGINE COLD)

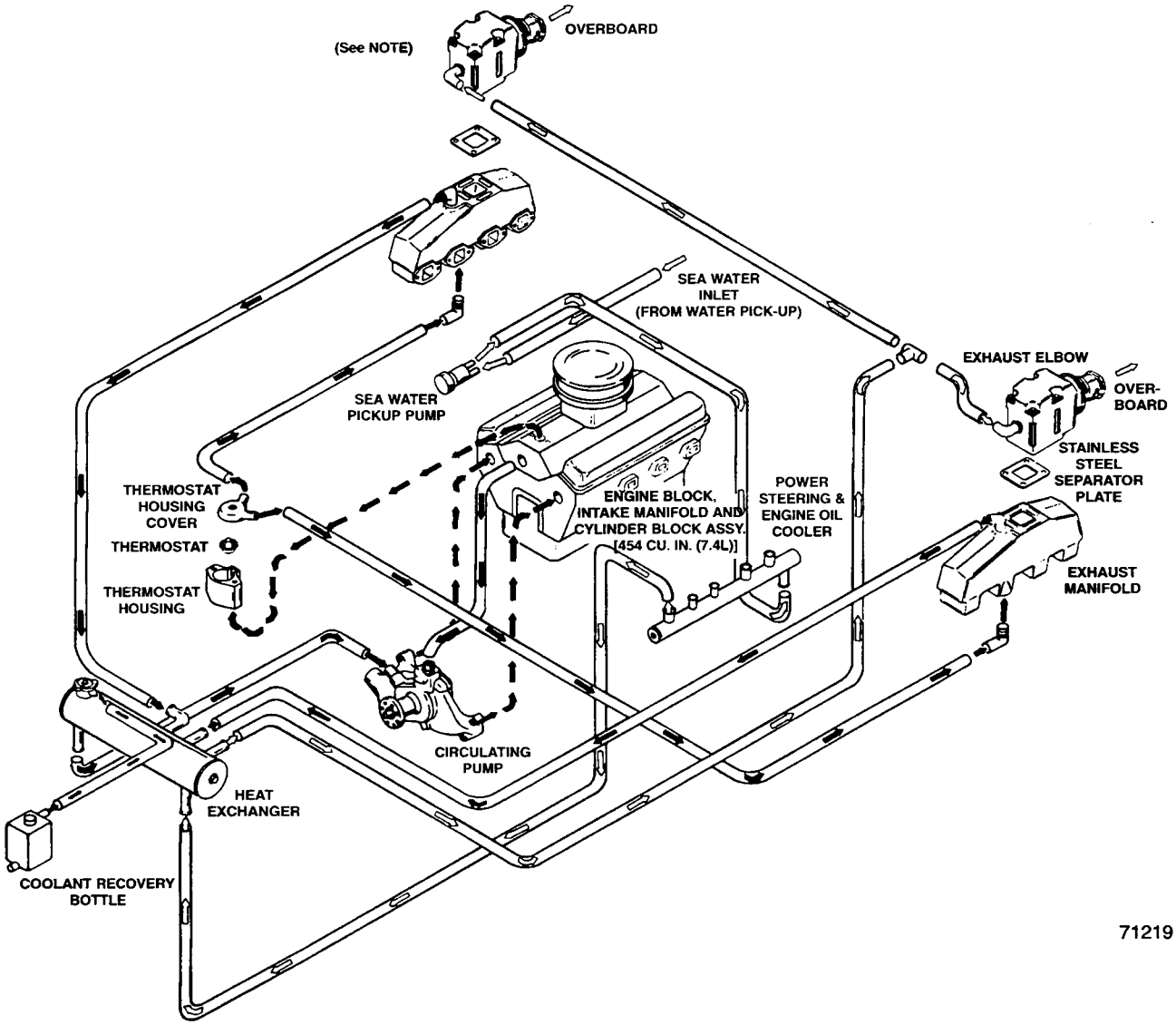


779-H1

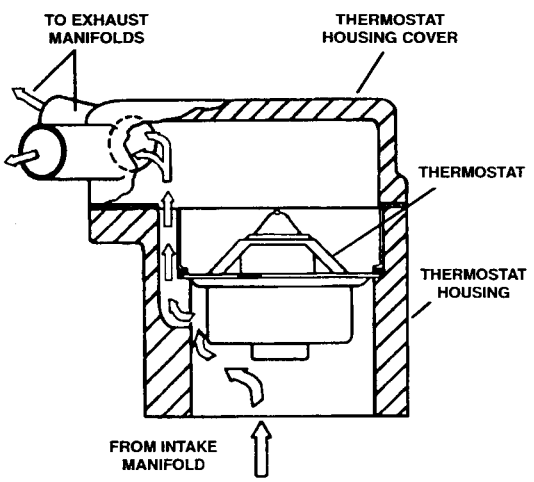
COOLANT FLOW THROUGH THERMOSTAT HOUSING WITH THERMOSTAT OPEN (ENGINE WARM)

MCM - 5.7 Litre (Bravo)

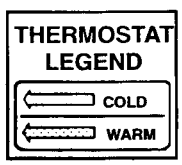
Front Mounted Closed Cooling System Flow Diagram

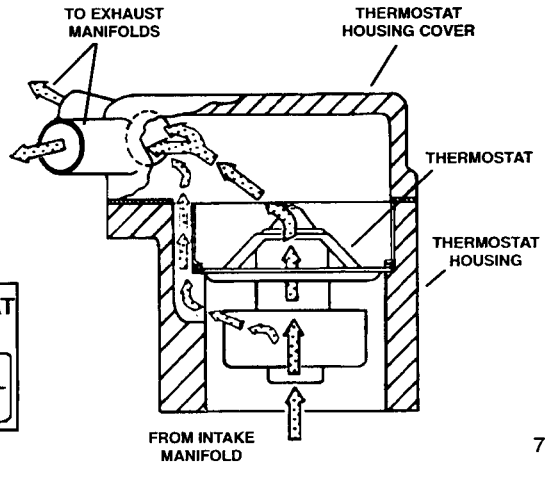


71219



COOLANT FLOW THROUGH THERMOSTAT HOUSING WITH THERMOSTAT CLOSED (ENGINE COLD)





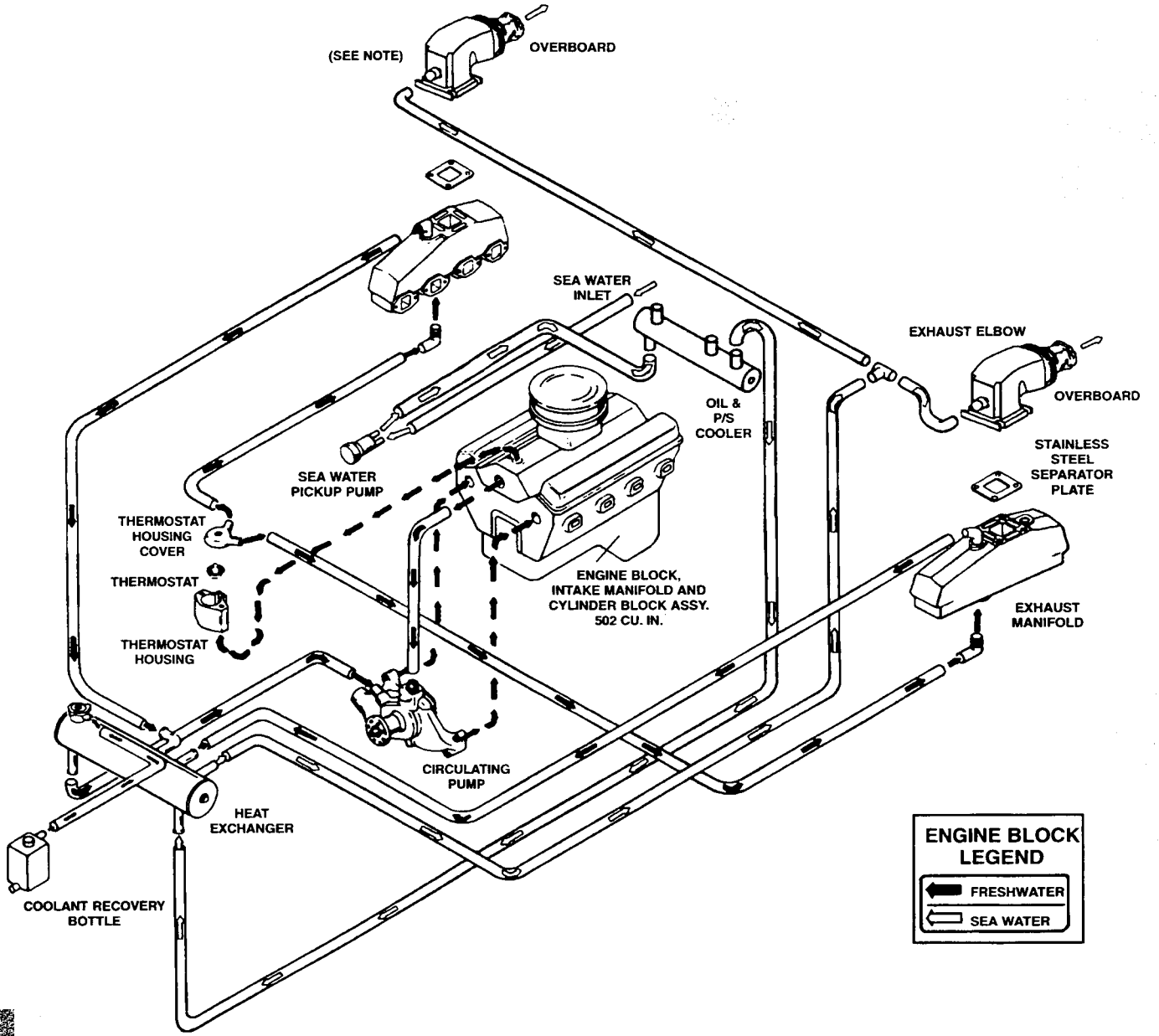
779-H2

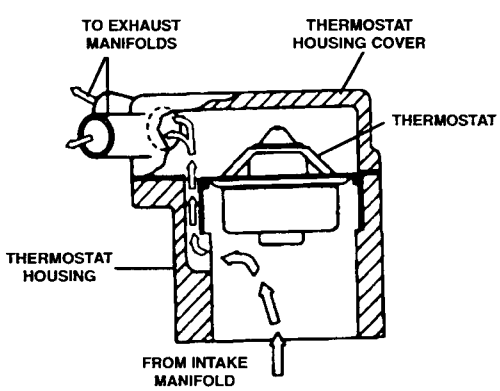
COOLANT FLOW THROUGH THERMOSTAT HOUSING WITH THERMOSTAT OPEN (ENGINE WARM)

NOTE: Refer to "Water Flow Diagram (continued)," page 6B-44, for additional flow diagrams when equipped with risers.

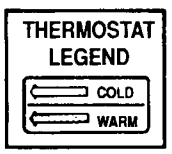
MCM - 7.4 Litre (Bravo) and MCM - 454 Magnum (Bravo)

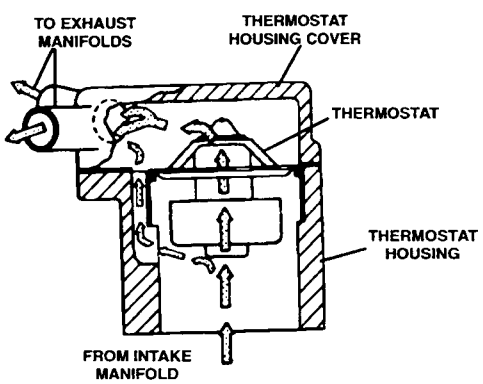
Front Mounted Closed Cooling System Flow Diagram





COOLANT FLOW THROUGH THERMOSTAT HOUSING WITH THERMOSTAT CLOSED (ENGINE COLD)





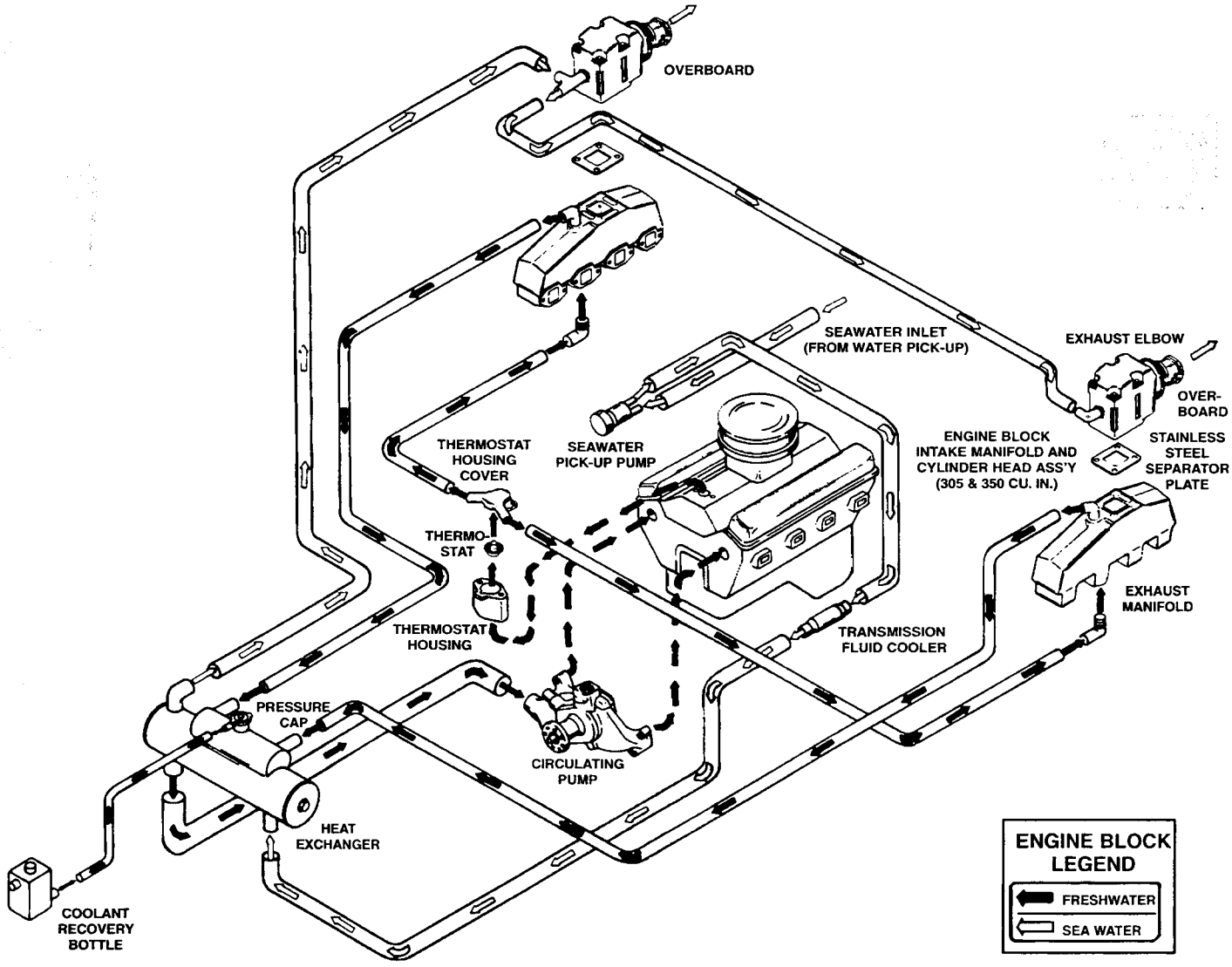
COOLANT FLOW THROUGH THERMOSTAT HOUSING WITH THERMOSTAT OPEN (ENGINE WARM)

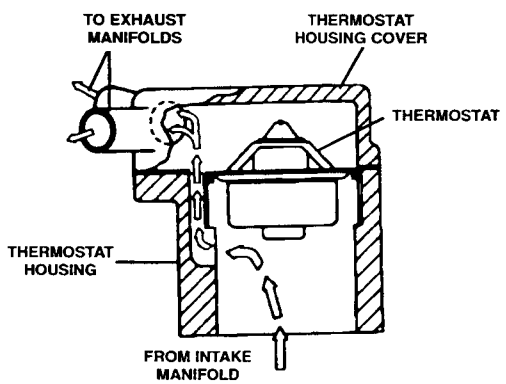
70781

NOTE: Refer to "Water Flow Diagram (continued)," page 6B-44, for additional flow diagrams when equipped with risers.

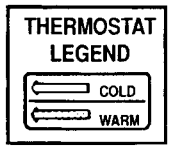
MCM - 502 Magnum (Bravo)

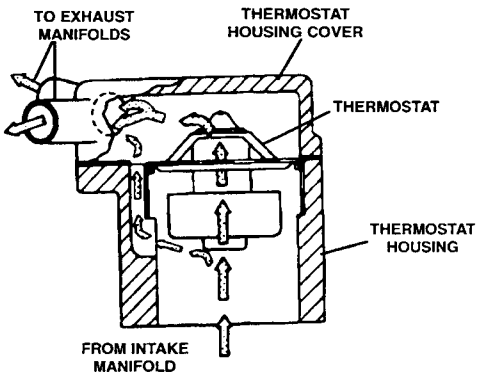
Front Mounted Closed Cooling System Flow Diagram





COOLANT FLOW THROUGH THERMOSTAT HOUSING WITH THERMOSTAT CLOSED (ENGINE COLD)



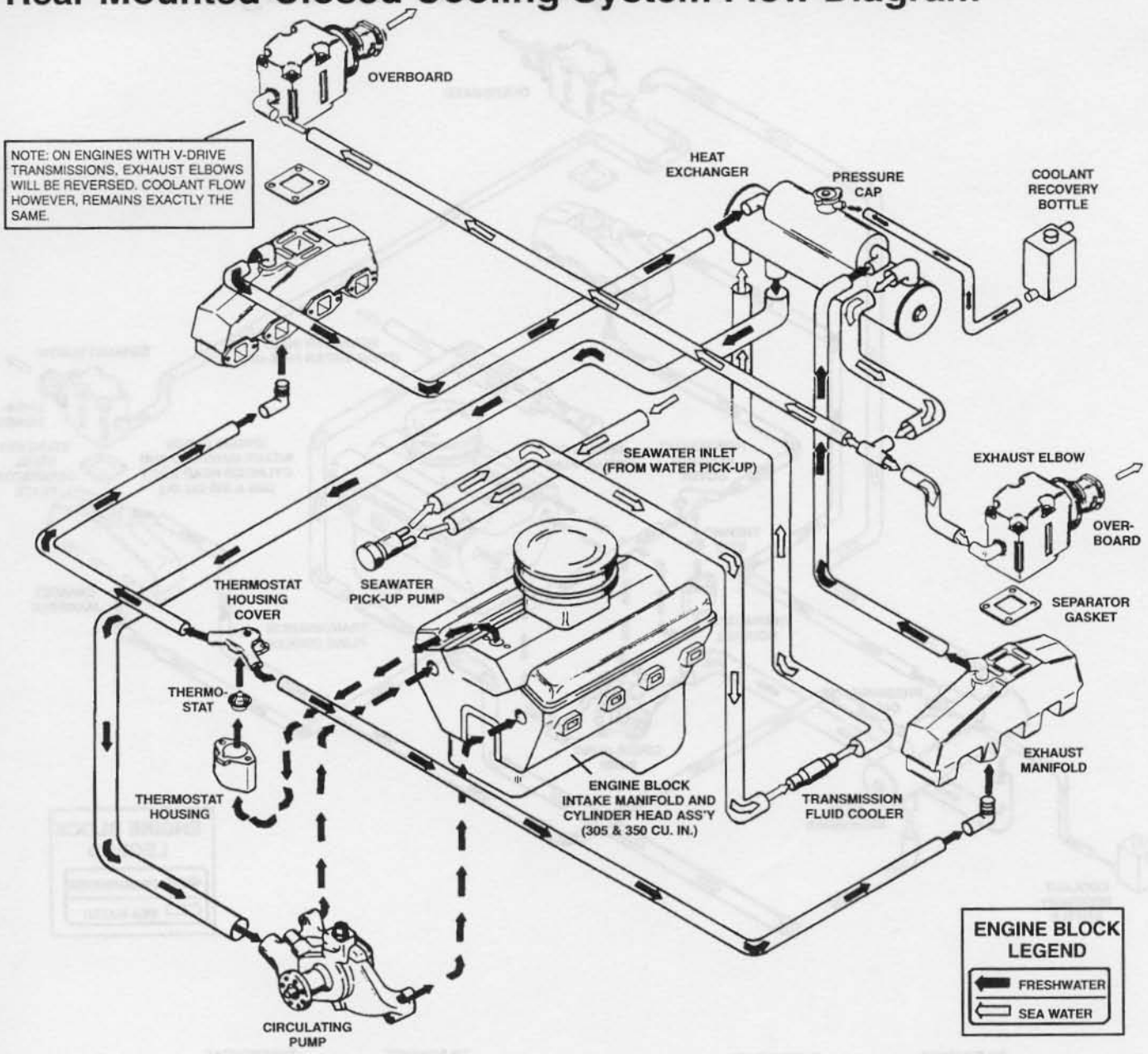


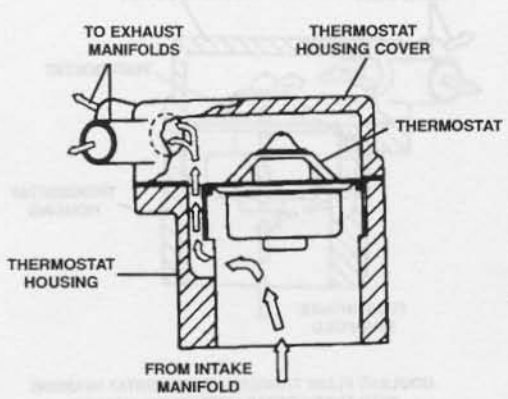
COOLANT FLOW THROUGH THERMOSTAT HOUSING WITH THERMOSTAT OPEN (ENGINE WARM)

779-H1

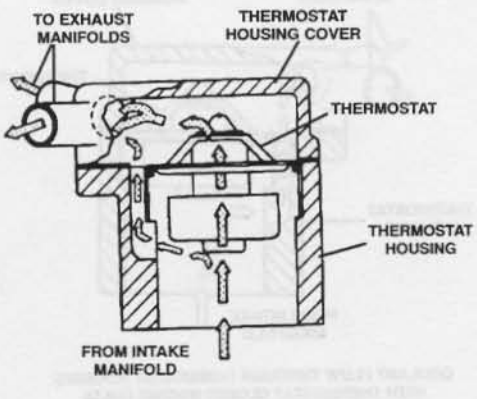
MIE - 5.0 Litre, 5.7 Litre (except V-Drive)

Rear Mounted Closed Cooling System Flow Diagram





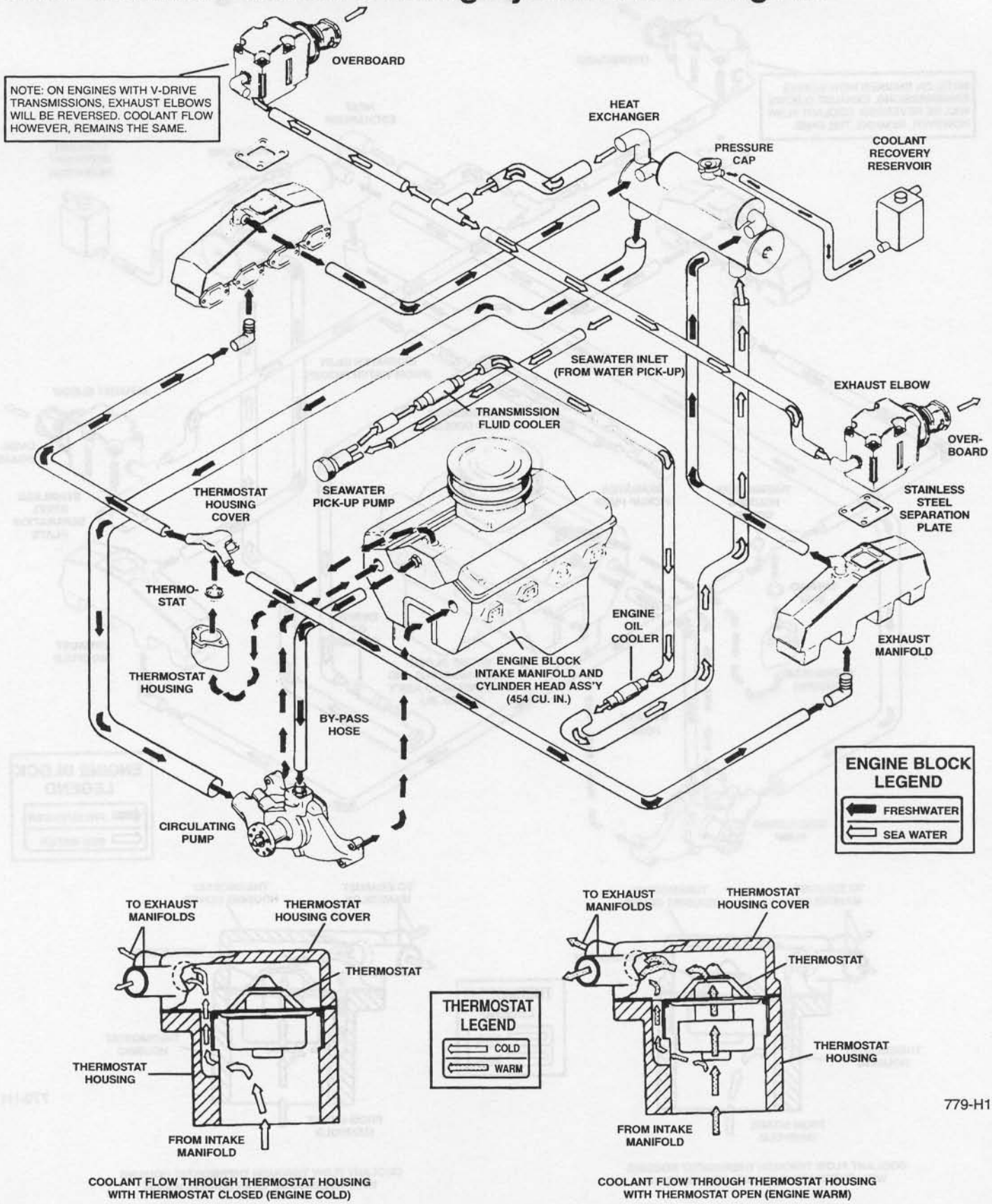
COOLANT FLOW THROUGH THERMOSTAT HOUSING WITH THERMOSTAT CLOSED (ENGINE COLD)



COOLANT FLOW THROUGH THERMOSTAT HOUSING WITH THERMOSTAT OPEN (ENGINE WARM)

MIE - 5.0 Litre, 5.7 Litre (In-Line and V-Drive)

Rear Mounted Closed Cooling System Flow Diagram

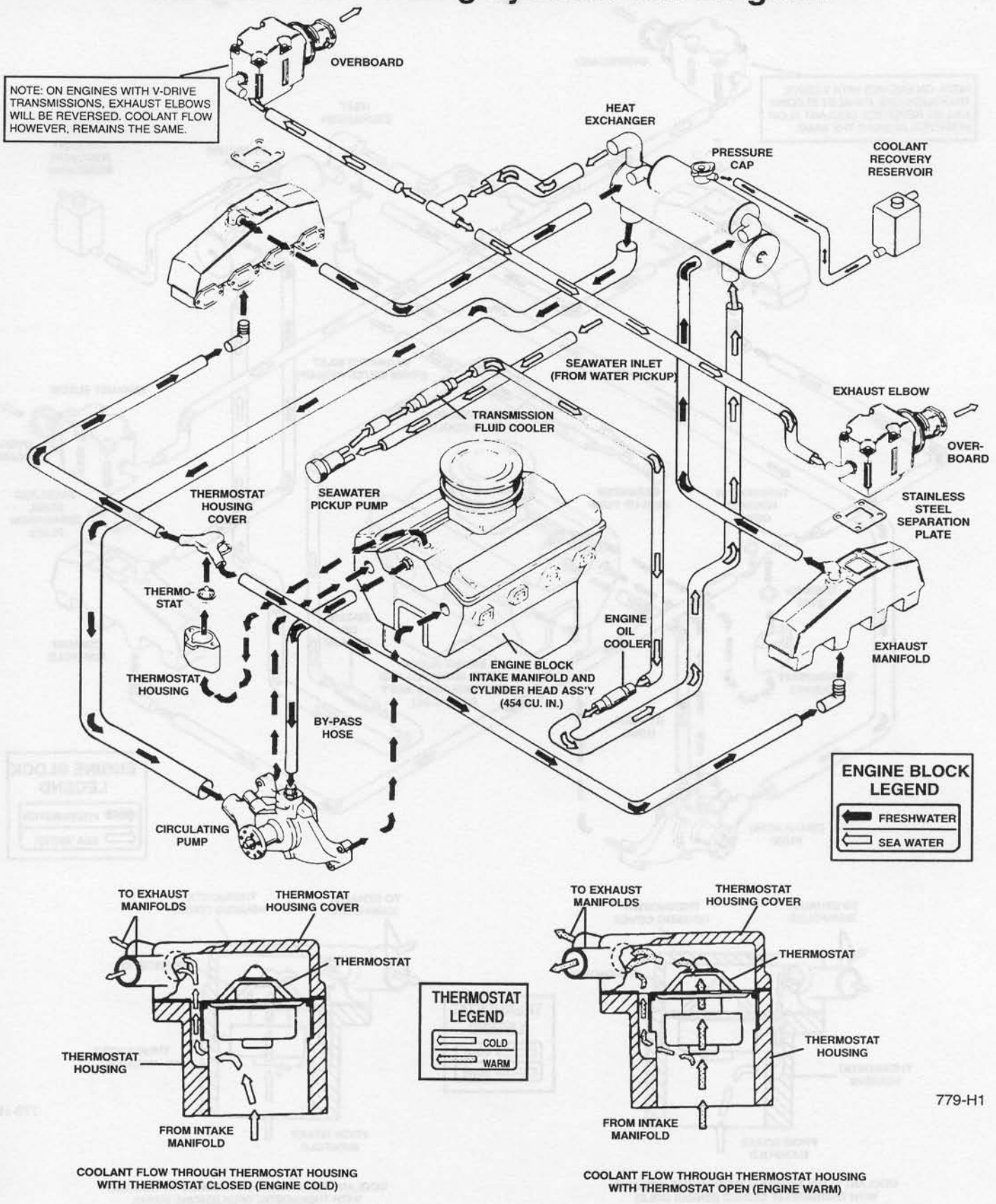


COOLANT FLOW THROUGH THERMOSTAT HOUSING WITH THERMOSTAT CLOSED (ENGINE COLD)

COOLANT FLOW THROUGH THERMOSTAT HOUSING WITH THERMOSTAT OPEN (ENGINE WARM)

MIE - 7.4 Litre (In-Line and V-Drive - with Borg-Warner Transmissions)

Rear Mounted Closed Cooling System Flow Diagram

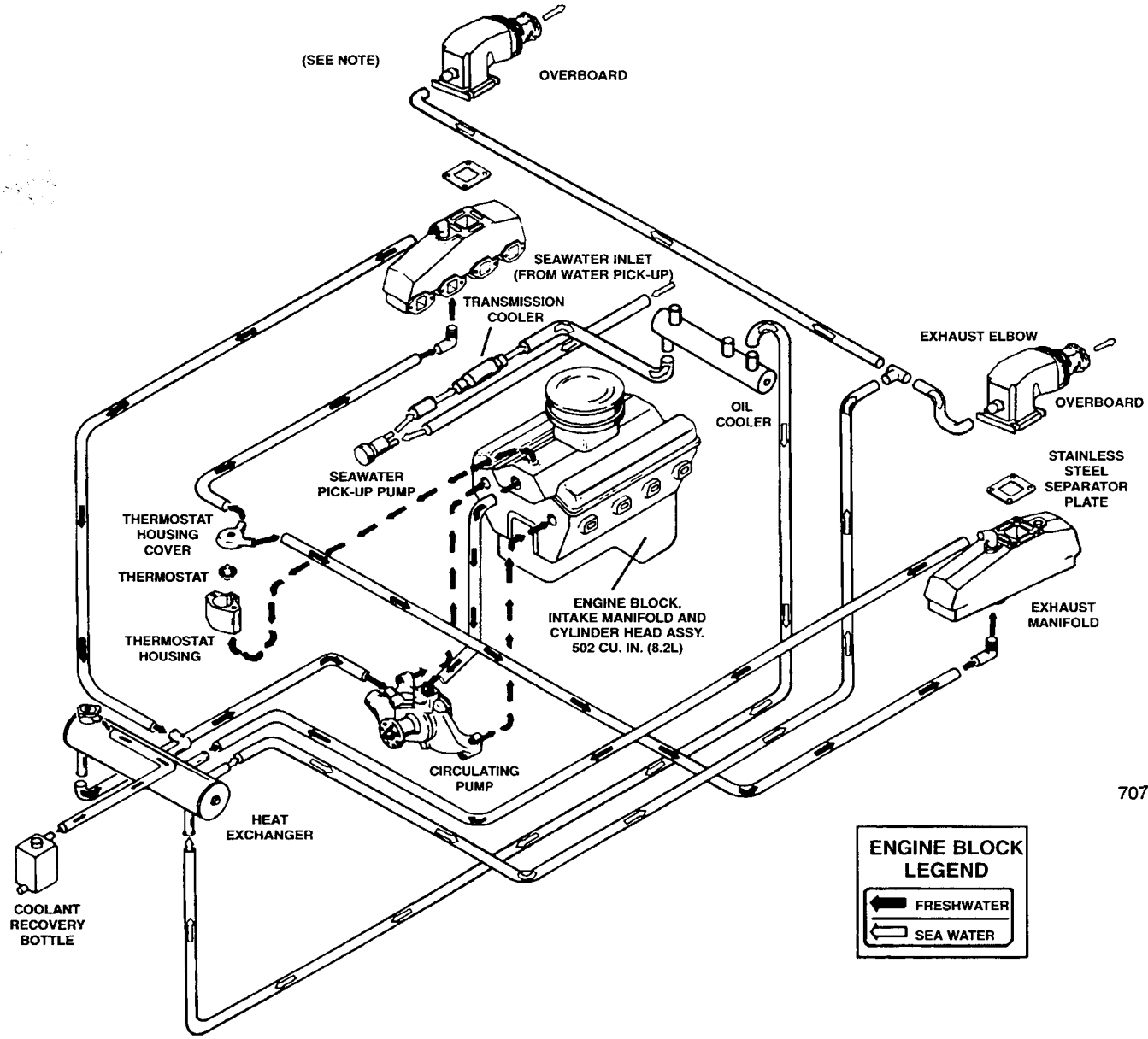


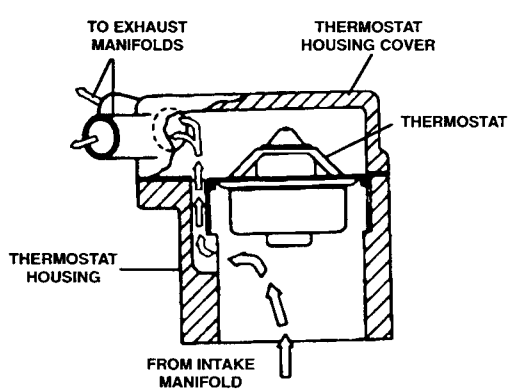
COOLANT FLOW THROUGH THERMOSTAT HOUSING WITH THERMOSTAT CLOSED (ENGINE COLD)

COOLANT FLOW THROUGH THERMOSTAT HOUSING WITH THERMOSTAT OPEN (ENGINE WARM)

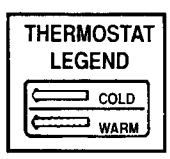
MIE - 7.4 Litre (with Hurth Transmissions)

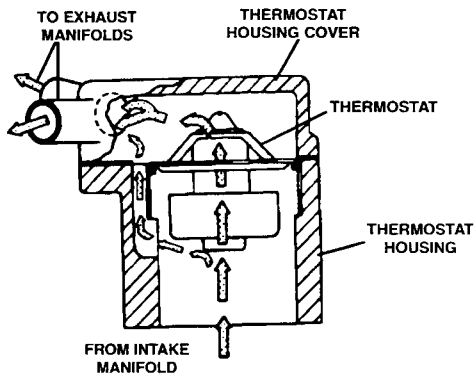
Rear Mounted Closed Cooling System Flow Diagram





COOLANT FLOW THROUGH THERMOSTAT HOUSING WITH THERMOSTAT CLOSED (ENGINE COLD)



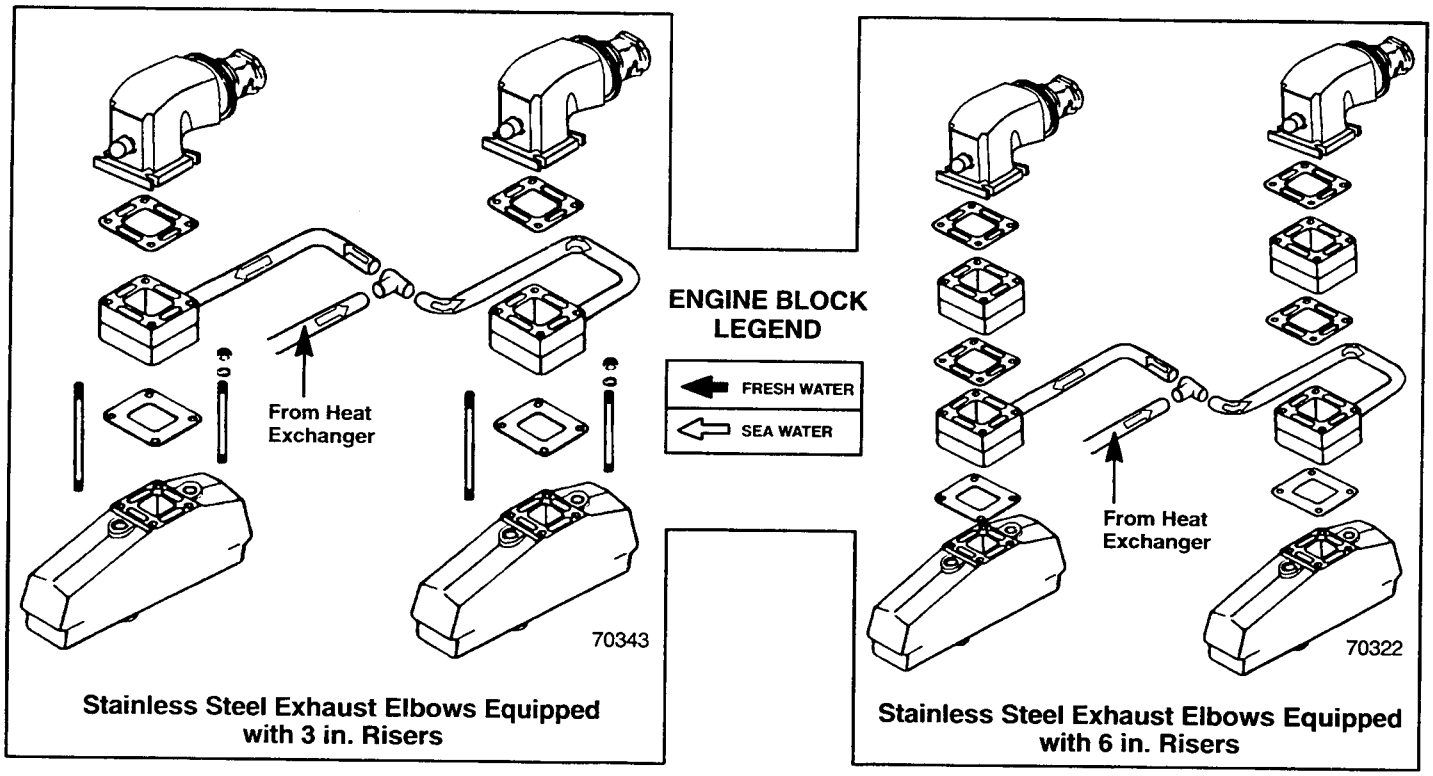


COOLANT FLOW THROUGH THERMOSTAT HOUSING WITH THERMOSTAT OPEN (ENGINE WARM)

NOTE: Refer to "Water Flow Diagram (continued)," (following Rear Mounted Closed Cooling System Flow Diagrams) for additional flow diagrams when equipped with risers.

MIE - 8.2 Litre (except V-Drive)

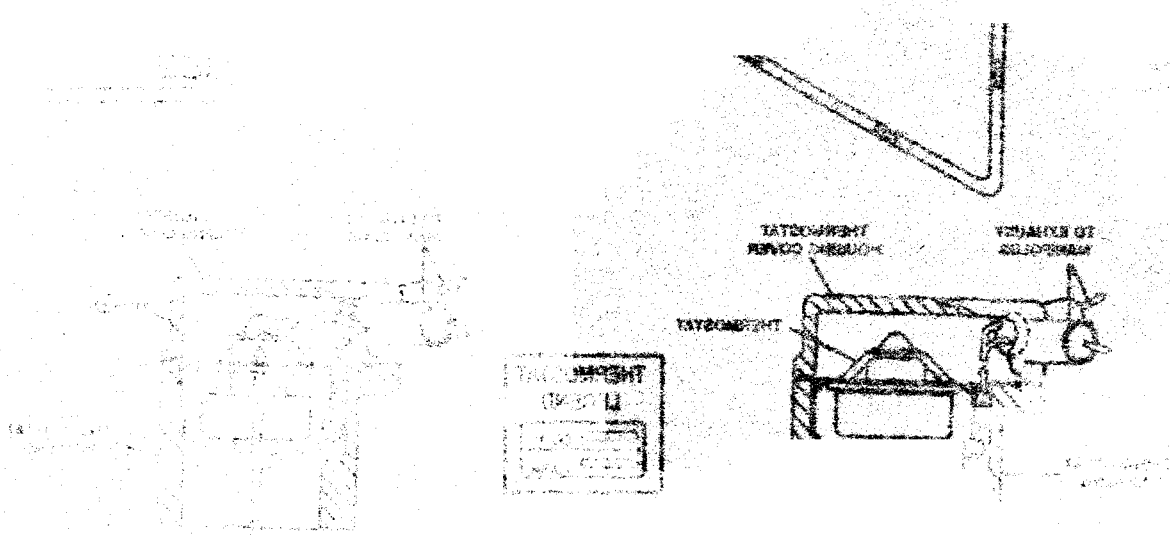
Water Flow Diagram (continued)



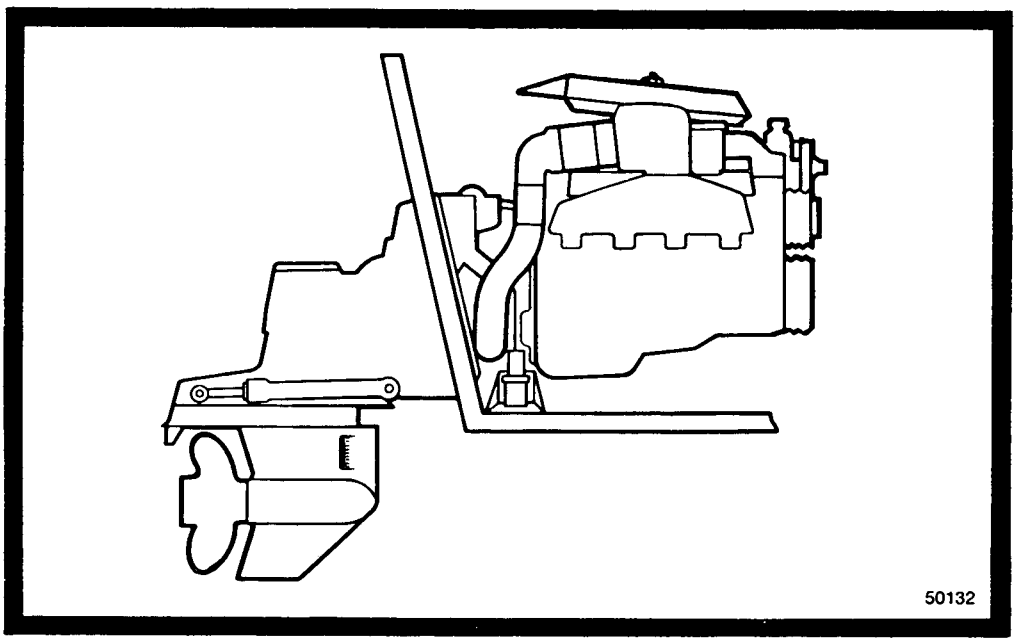
Stainless Steel Exhaust Elbows Equipped with 3 in. Risers

Stainless Steel Exhaust Elbows Equipped with 6 in. Risers

Additional Flow Diagram for MCM - 7.4 (Bravo), 454 Magnum (Bravo), 502 Magnum (Bravo), and MIE - 8.2 Litre, equipped with stainless steel exhaust elbows and 3 in. (76mm) or 6 in. (152mm) exhaust elbow risers.



EXHAUST SYSTEM



GENERAL INFORMATION

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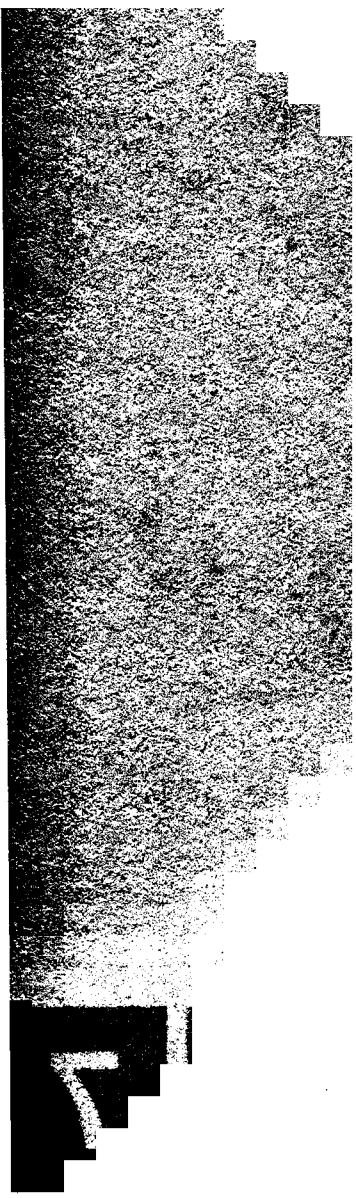
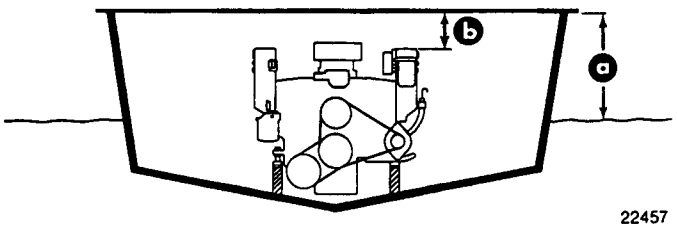


Exhaust System Requirements

IMPORTANT: It is the responsibility of the boat manufacturer or installing dealer to properly locate the engine and install the exhaust system. Improper installation may allow water to enter the exhaust manifolds and combustion chambers and severely damage the engine. Damage caused by water in the engine will not be covered by MerCruiser Limited Warranty, unless this damage is the result of defective part(s).

Determine if exhaust elbow risers are required by taking measurements (a) and (b), with boat at rest in the water and maximum load aboard. Subtract (b) from (a). If (a) minus (b) is less than specified in chart, select appropriate size exhaust elbow riser kit and exhaust extension kit that will correctly position exhaust elbow.



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a - From Waterline to Reference Point
b - From Highest Point on Exhaust Elbow to Same Reference Point

Exhaust Elbow Measurement

Model	(a) Minus (b) Must Be in. (mm) or More
All V8 MCM & MIE	13 in. (330mm)

When designing and installing exhaust system, it is very important that the following points be taken into consideration:

1. System layout and construction must prevent cooling system discharge water from flowing back into engine and also must prevent seawater from entering engine via exhaust system.
2. The exhaust hoses and pipes must not be higher than exhaust elbows at any point.
3. The exhaust outlet (for routing exhaust to outside of boat) must be located so that a minimum of 1/2 in. (13mm) per foot (305mm) downward pitch (drop) exists in the exhaust hose or pipe from the engine exhaust elbow to the outlet, with a minimum drop of 4 in. (100mm) overall. (This is an American Boat & Yacht Council recommendation.) The drop must be constant so that a low spot does not exist at any point in the exhaust hose or pipe.
4. Exhaust outlet must be slightly above the waterline with boat at rest in the water and full load aboard. Exhaust outlet should be equipped with an internal shutter to prevent seawater from running back into exhaust system. The use of an exhaust flapper on each outlet also is recommended.
5. System must not cause excessive back pressure. Back pressure MUST NOT exceed 4 in. (100mm) of mercury when measured with a mercury manometer at exhaust elbow outlets. Minimum exhaust hose sizes are given in chart.

Minimum Hose Size		
Model	**Single**	**Dual**
5.7/ 5.7 Ski	4 in. (102mm)	3 in. (76mm)
7.4	5 in. (127mm)	3 in. (76mm)
8.2	5 in. (127mm)	4 in. (102mm)

6. Exhaust hoses must be connected to exhaust elbows so that they do not restrict the flow of discharge water from the elbow. If hoses are connected incorrectly, a hot spot in the hose can occur, and can eventually burn thru.
7. **5.7/7.4/8.2:** These models require a 4 in. (102mm) I.D. exhaust hose. A kit is available to reduce from the 4 in. to 3 in. (76mm). Refer to "Quicksilver Accessories Guide," for kit part number.

THRU-TRANSOM EXHAUST MODELS

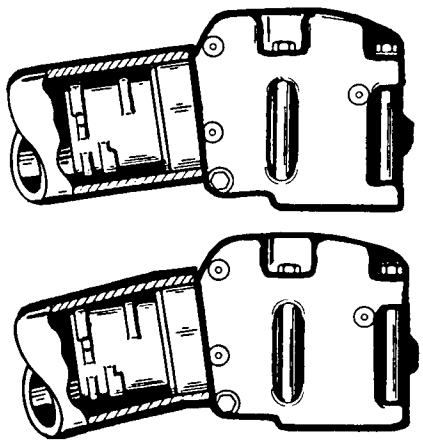
When designing and installing exhaust system, the following must be observed:

1. Exhaust flanges must be of proper size to be accommodate 4 in. (102mm) I.D. exhaust hoses, must be equipped with internal water shutters, and use an exhaust flapper over each outlet.
2. Exhaust hoses and pipes must not be higher than exhaust elbows at any point.
3. The exhaust outlet must be located so that a minimum of 1/2 in. (13mm) drop per foot (305mm) downward pitch exists in the exhaust hose from the engine exhaust elbow to the outlet; (this is an American Boat & Yacht Council recommendation). The drop must be constant so that a low spot does not exist at any point in the exhaust hose.
4. Exhaust outlet must be slightly above the waterline with boat at rest in the water, and full load aboard.

5. Back pressure must not exceed 4 in. (102mm) of mercury when measured with a mercury manometer to exhaust elbow outlets.
6. Exhaust hoses must be secured at each connection with two (2) hose clamps.
7. Exhaust hoses must not restrict discharge water flow at exhaust elbow.

CORRECT

INCORRECT



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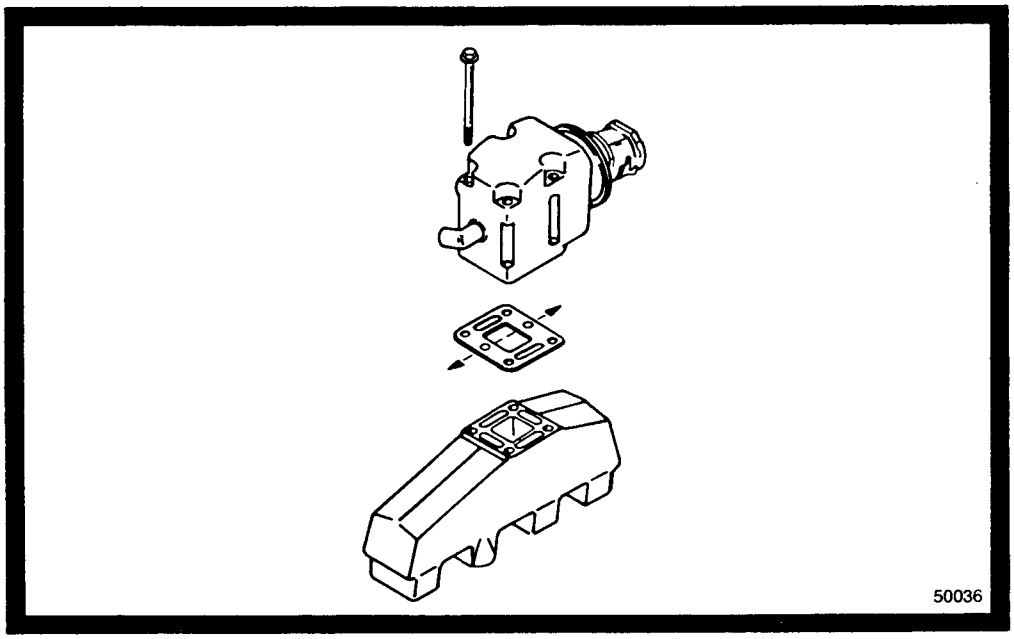
Hose Connection

EXHAUST SYSTEM



EXHAUST MANIFOLDS/ELBOWS

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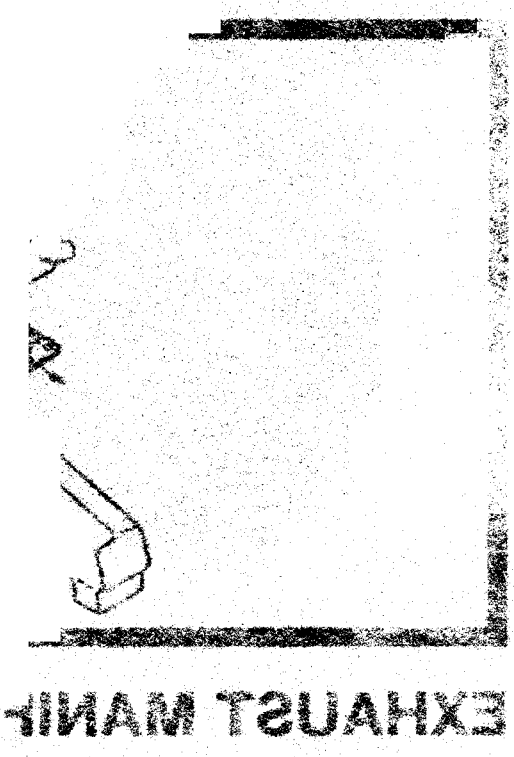


Torque Specifications

Fastener Location	Lb. Ft. (N·m)
Hose Clamps	Securely
Exhaust Elbow	25 (34)
Exhaust Manifold	25 (34)

Sealants

Quicksilver Perfect Seal	92-34227-1

Removal

⚠WARNING
If installing closed cooling system on an engine which is already installed in boat, disconnect BOTH battery cables from battery before proceeding with installation to prevent possible injury or damage to equipment should wires be accidentally shorted.

⚠CAUTION
Before proceeding with kit installation, drain water from exhaust manifolds and cylinder block. Water MUST BE DRAINED from exhaust manifolds or water will run into engine combustion chambers when exhaust elbows are removed.

1. Disconnect battery cables from battery.
2. Drain water from manifold and exhaust elbow.
3. Disconnect exhaust bellows and cooling hoses.
4. **Starboard Manifold:**
   a. Disconnect both shift cables.
   b. Disconnect instrument harness plug from engine harness.
   c. Remove shift plate assembly from exhaust elbow. (MCM only)
   d. Remove bolt holding fuel filter bracket to exhaust manifold.

   Port Manifold:
   a. Remove ignition amplifier from exhaust elbow.
   b. Remove remote oil filter and bracket (if equipped).
5. Remove exhaust elbow.
6. Remove exhaust manifold fasteners; remove manifold assembly and discard gaskets.

Cleaning and Inspection

1. Clean gasket material from all surfaces and wash parts in solvent.
2. Inspect all parts carefully. Machined surfaces must be clean and free of all marks and deep scratches, or water and exhaust leaks may result.
3. Check water passages for foreign material. Passages must be clean for efficient cooling.
4. If more thorough inspection is desired, pipe plugs may be removed from exhaust manifold and exhaust elbow.

IMPORTANT: If plugs are removed, coat threads with Perfect Seal before reinstalling.

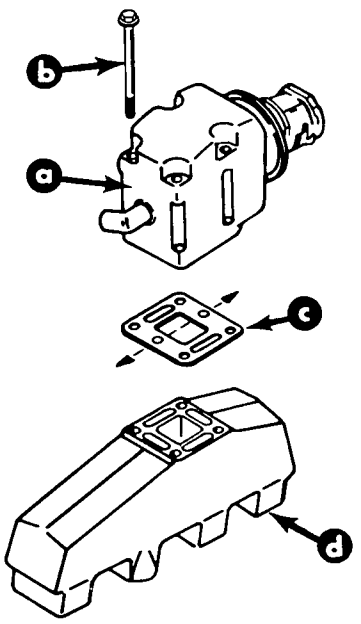
5. Check for cracks.
6. To test manifold body for leaks, block off plates, plugs, or short hoses with plugged ends must be used. One block off plate must have a threaded hole for attaching compressed air hose. Use new gaskets when installing block off plate(s). Apply 40 PSI (276 kPa) of air pressure and submerge manifold in water. Air bubbles will indicate a leak.

Installation

1. Using new gasket, install exhaust manifold to cylinder head. Torque fasteners to 25 lb. ft. (34 N·m).

IMPORTANT: See Section 7, Part C if exhaust risers are used.

2. Follow instructions "a" or "b":
   a. **On Engines with Cast Iron Exhaust Elbows:** Install exhaust elbow. Torque fasteners to 25 lb. ft. (34 N·m).



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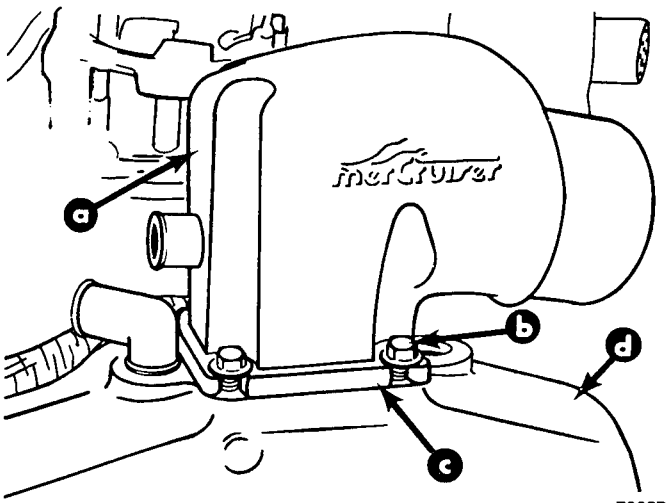
a - Cast Iron Exhaust Elbow
b - Fastener(s)
c - Gasket
d - Exhaust Manifold

Typical Cast Iron Exhaust Elbow Installation

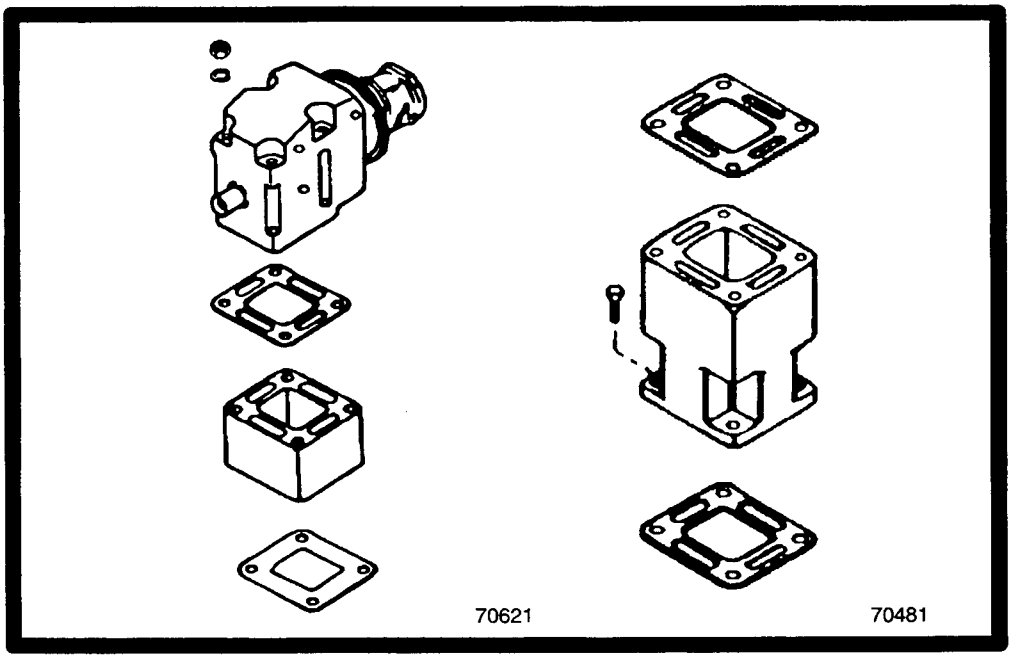
b. **On Engines with Stainless Steel Exhaust Elbows:** Install exhaust elbow. Torque fasteners to 23-32 lb. ft. (31.2 - 43.3 N·m).



a - Stainless Steel Exhaust Elbow
b - Fastener(s)
c - Gasket
d - Exhaust Manifold

Typical Stainless Steel Exhaust Elbow Installation

EXHAUST SYSTEM



EXHAUST RISERS

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Exhaust Riser (Kit) Identification

MODEL	3 INCH (76MM) RISER - KIT PART NUMBER	6 INCH (152MM) RISER - KIT PART NUMBER
MCM - 5.0, 5.0LX 5.7, 350 Magnum, MIE - 5.0, 5.7, 7.4	93320A3 (NOTE 1)	93322A3 (NOTE 1)
MCM 5.0,, 5.0LX, 5.7 Alpha	93320A6 (NOTE 2)	93322A4 (NOTE 2)
MCM 350 Magnum, 5.7 Bravo, 454 Magnum, 502 Magnum, MIE 5.7, 7.4, 8.2	93320A7 (NOTE 3)	93322A5 (NOTE 3)

NOTE 1: Engine Serial Numbers D445799 and below, and D434499 and below, with 3 inch (76mm) or 4 inch (101mm) cast iron elbows.

NOTE 2: Engine Serial Numbers D445800 and above, with 4 inch (101mm) cast iron elbows.

NOTE 3: Engine Serial Numbers D445800 and above and D434500 and above, with 4 inch (101mm) stainless steel exhaust elbows, including engines converted to stainless exhaust elbows.

IMPORTANT: All listed MCM and MIE Models can be adapted to 9 inch (228mm) exhaust risers by stacking 3 inch (76mm) riser kit (Part Number 93320A7) and 6 inch (152mm) riser kit (Part Number 93322A4).

Additional Kits:

There may be one or more of the following additional kits installed or needed when risers are installed:

WHEN MCM (STERN DRIVE) EQUIPPED		
Item Required	**Engine CID (Litre)**	**Kit Part Number**
EXHAUST EXTENSION	V-8 305/350 (5.0/5.7)	14801A1
	V-8 454/502 (7.4/8.2)	14802A1

WHEN EQUIPPED WITH REMOTE OIL FILTER	
Item Required	**Part Number**
Remote Oil Filter Hose Kit	32 - 818748A1

WHEN EQUIPPED WITH MUFFLERS	
Item Required	**Part Number**
Quicksilver Gaskets (2)	27 - 818832
Riser Stud Kit	17833A6

WHEN EQUIPPED WITH FRONT MOUNTED CLOSED COOLING: 454 MAGNUM, 502 MAGNUM AND 8.2 L ONLY	
Item Required	**Part Number**
Additional Hose and Installation Kit	17833A7

Torque Specifications

FASTENER LOCATION	LB. FT. (N·m)
Exhaust Elbow	23 - 32 (32 - 43)
Exhaust Riser	23 - 32 (32 - 43)

Sealants

SEALANT	
Quicksilver Perfect Seal	92 - 34227 --1

Replacement Information

Engine Preparation and Parts Removal

⚠CAUTION

If engine has been in service exhaust elbows and manifolds must be drained to prevent water from entering combustion chambers.

1. Drain exhaust elbows and exhaust manifolds.
2. Remove any items attached to the elbows on the engine and carefully lay them aside. Remember their positioning for reassembly later.
3. Remove fasteners retaining exhaust elbows and risers to manifolds and retain. Remove exhaust elbows.
4. Remove and discard old gaskets. Clean gasket mating surfaces on elbows, manifolds and risers.

Riser Installation

NOTE: Refer to "Special Installation Instructions for MCM 454 Magnum, 502 Magnum, and MIE 8.2L With Front Mounted Closed Cooling System" outlined later in this section for these models. (See Table of Contents.)

Follow instructions appropriate to your model and riser kit:

1. Refer to Installation Diagrams following and assemble riser and components following instructions "a" or "b":

IMPORTANT: Restrictor gaskets or manifold separator gaskets must be installed in order shown.

⚠CAUTION

If engine is equipped with closed cooling, MANIFOLD SEPARATOR GASKET MUST BE INSTALLED ONLY ON EXHAUST MANIFOLD. Failure to install separator gaskets on exhaust manifolds, or to install in a location other than shown, will result in severe engine damage.

a. Assemble studs to exhaust manifold and position all gaskets as shown between risers. Install elbow on riser(s) and studs. Attach using nuts and washers.

b. After positioning all gaskets as shown, assemble exhaust elbow to riser using studs or screws. Attach hex head screws through riser and into manifold.

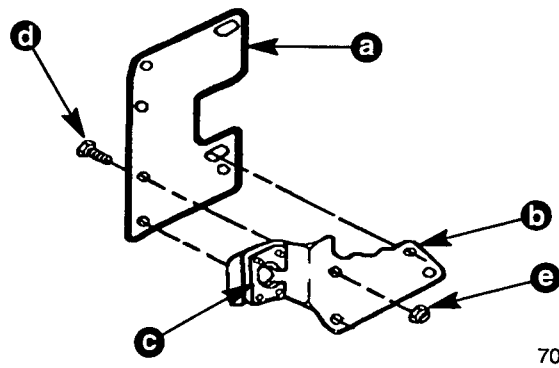
NOTE: Drain plugs in risers must be positioned facing flywheel end of engine, unless otherwise noted.

2. Torque all fasteners, in a diagonal pattern, to 23-32 lb.ft. (32-43 N·m).
3. Place spacers between riser plate, if so equipped, and fasten with existing nuts. Tighten securely.
4. Reattach and tighten securely all parts previously removed from elbow to appropriate position on riser bracket, if so equipped.

IMPORTANT: On elbows with ignition amplifier, be sure to reconnect amplifier and wiring harness ground wires to one of the attaching screws and that amplifier spacers are installed between amplifier and exhaust elbow. Tighten screws securely.

IMPORTANT: On elbows with shift plate (MCM only) reinstall shift plate and tighten fasteners securely, then readjust shift cables as outlined in appropriate "Stern Drive Service Manual".

5. Assemble harness bracket and plastic backup plate, if so equipped, using four small screws.



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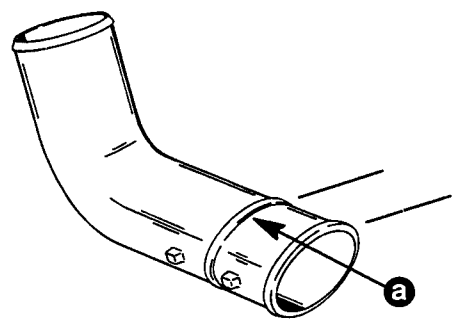
a - Riser Bracket
b - Harness Plate
c - Back-up Plate (1) - Screws (4) - 7/8 in. (22mm)
d - Screws (6) - 3/4 in. (19mm)
e - Nuts (6)

6. Install appropriate Exhaust Extension (See "Additional Kits:") for MCM Models. Tighten hose clamps securely.



a - Cut Here for Use with 3 Inch (76mm) Riser

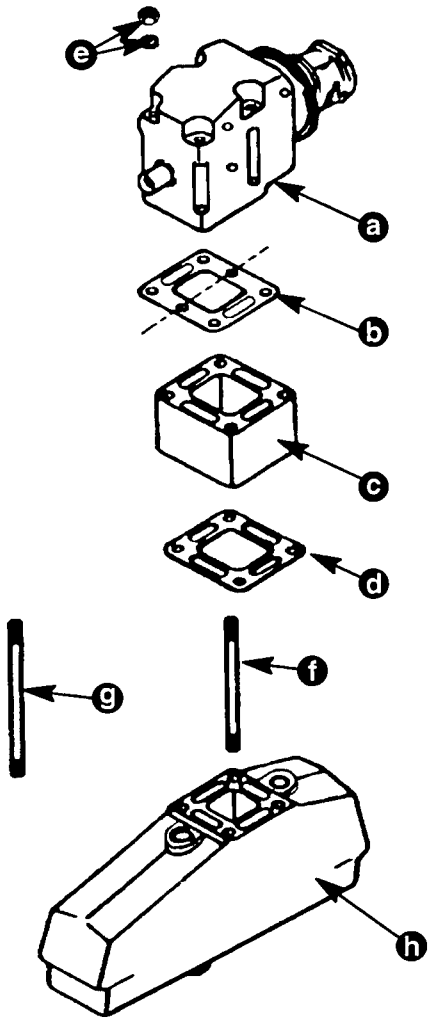
50930

Typical Exhaust Extension (See "Additional Kits:" at front of section for kit Part Numbers.)

7. Refill closed cooling system, if so equipped. (Refer to SECTION 6B - Closed Cooled Models.)
8. Upon first start-up of engine check for leaks.

Installation Diagrams

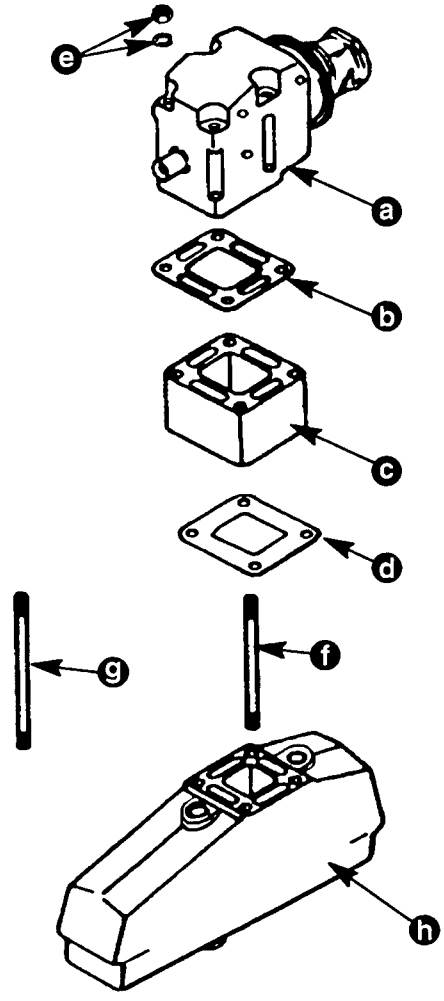
3 INCH (76mm) EXHAUST RISER KIT 93320A3



70621

Standard Cooling

a - Exhaust Elbow (Cast Iron – 3 Inch (76mm)
b - Restrictor Gasket
c - Exhaust Riser – 3 in. (76mm)
d - Open Gasket (4 slots)
e - Nut (8) Washer (8)
f - Stud (8) – 9-9/16 in. (243mm)
g - Stud (2) – 10-9/16 in. (268mm) (used only on remote oil filter if so equipped)
h - Exhaust Manifold



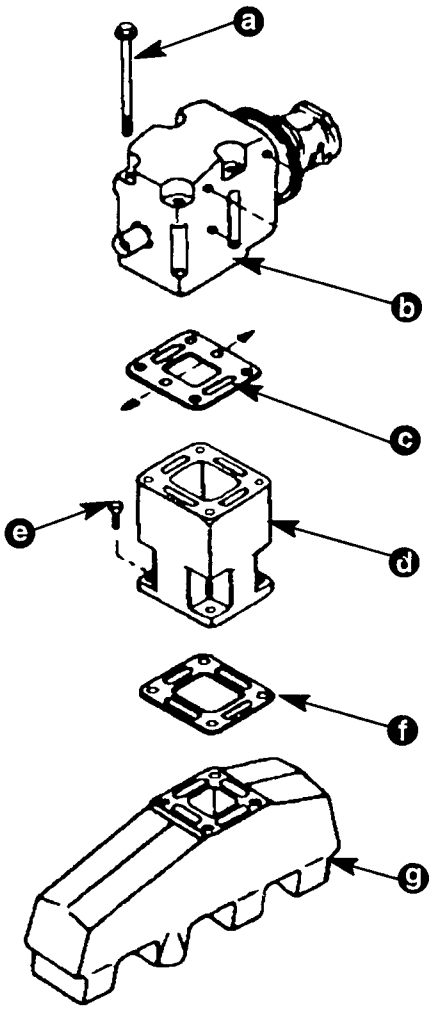
70621

Closed Cooling

a - Exhaust Elbow (Cast Iron – 3 Inch (76mm)
b - Open Gasket (4 slots)
c - Exhaust Riser – 3 in. (76mm)
d - Manifold Separator Gasket
e - Nut (8) Washer (8)
f - Stud (8) – 9-9/16 in. (243mm)
g - Stud (2) – 10-9/16 in. (268mm) (used only on remote oil filter if so equipped)
h - Exhaust Manifold

Installation Diagrams

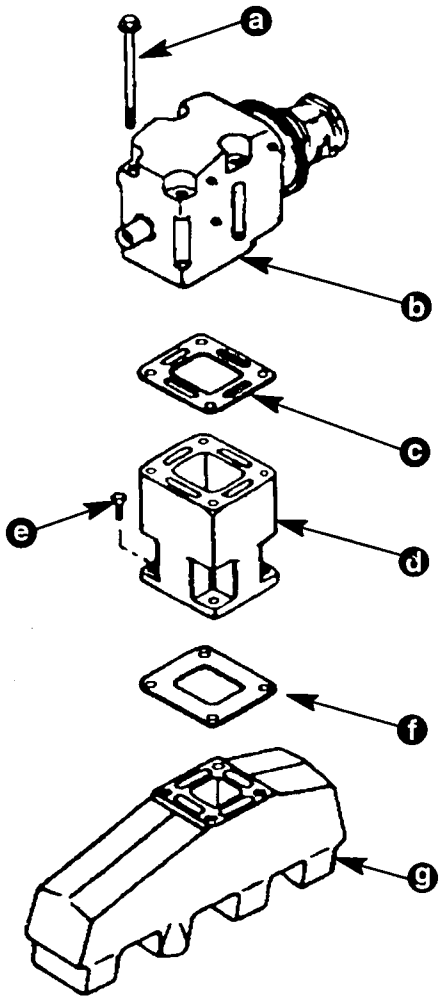
6 INCH (152mm) EXHAUST RISER KIT 93322A3



70482

Standard Cooling

a - Long Bolts (4) – Elbow-to-Riser
b - Exhaust Elbow [Cast Iron – 3 Inch (76mm)]
c - Restrictor Gasket
d - One-Piece 6 Inch (152mm) Riser
e - Short Bolts and Lockwashers (4) – Riser-to-Manifold
f - Open Gaskets (4 slots)
g - Exhaust Manifold



70482

Closed Cooling

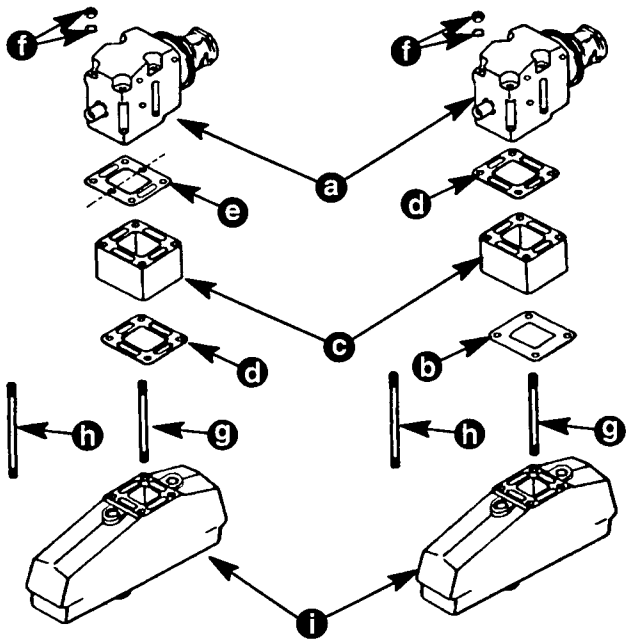
a - Long Bolts (4) – Elbow-to-Riser
b - Exhaust Elbow [Cast Iron – 3 Inch (76mm)]
c - Open Gasket (4 slots)
d - One-Piece 6 Inch (152mm) Riser
e - Short Bolts and Lockwashers (4) – Riser-to-Manifold
f - Manifold Separator Gasket
g - Exhaust Manifold

Installation Diagrams

3 INCH (76mm) EXHAUST RISER KIT 93320A6

INSTALLATION ON MODELS WITHOUT MUFFLERS

a - Exhaust Elbow [Cast Iron – 4 Inch (101mm)]
b - Restrictor Gasket
c - Exhaust Riser – 3 in. (76mm)
d - Open Gasket (4 slots)
e - Manifold Separator Gasket
f - Nut (8) Washer (8)
g - Stud (8) – 9-3/8 in. (238mm)
h - Stud (2) – 10-3/8 in. (264mm) (used only on remote oil filter if so equipped)
i - Exhaust Manifold

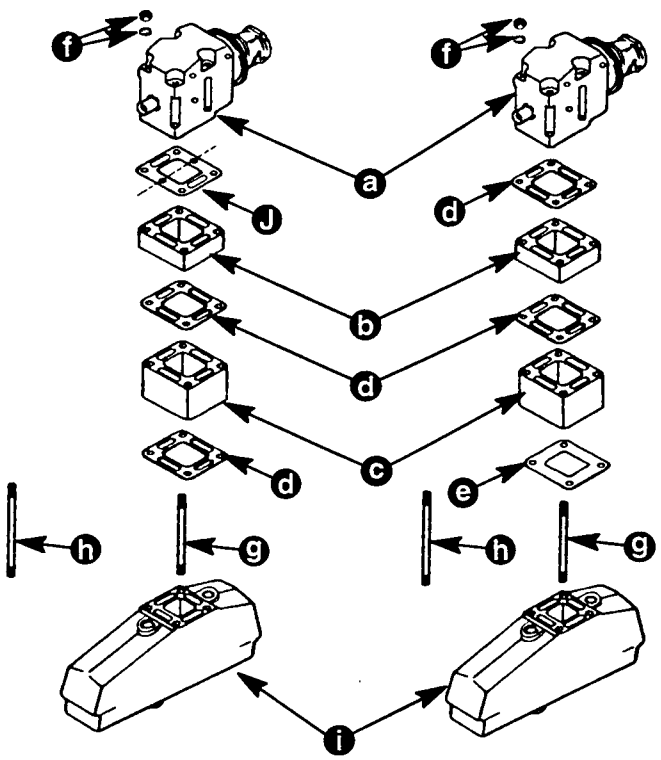


70621

Standard Cooling Closed Cooling

INSTALLATION ON MODELS WITH MUFFLERS

a - Exhaust Elbow [Cast Iron – 4 Inch (101mm)]
b - Muffler Spacer 1-1/4 in. (32mm)
c - Exhaust Riser 3 in. (76mm)
d - Open Gasket (4 slots)
e - Manifold Separator Gasket
f - Nuts (8) Washers (8)
g - Stud (8) – 10-7/8 in. (276mm)
h - Stud (2) – 11-7/8 in. (302mm) (used only on remote oil filter if so equipped)
i - Exhaust Manifold
j - Restrictor Gasket



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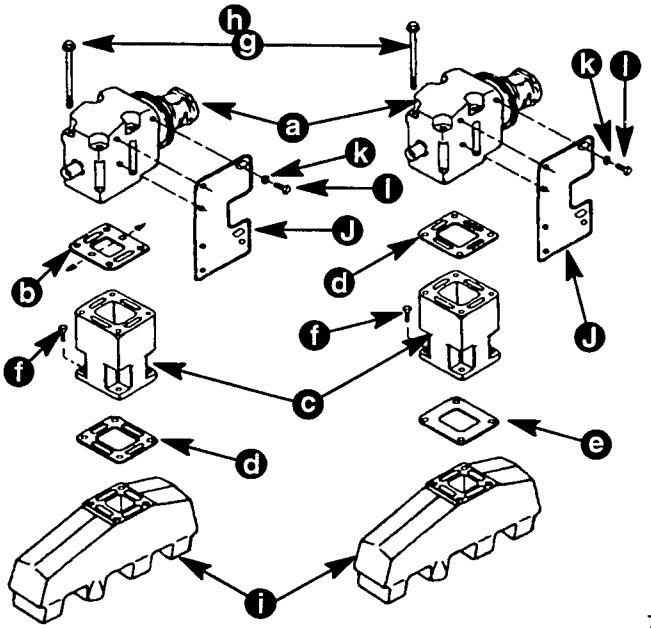
Standard Cooling Closed Cooling

Installation Diagrams

6 INCH (152mm) EXHAUST RISER KIT 93322A4

INSTALLATION ON MODELS WITHOUT MUFFLERS

a - Exhaust Elbow [Cast Iron – 4 Inch (101mm)]
b - Restrictor Gasket
c - Exhaust Riser – 6 in. (152mm)
d - Open Gasket (4 slots)
e - Manifold Separator Gasket
f - Hex Head Screw (4) – 1 in. (25mm)
g - Bolt (8) – 6 in. (152mm)
h - Bolt (2) – 7 in. (178mm) (used only on remote oil filter, if so equipped)
i - Exhaust Manifold
j - Riser Bracket (2)
k - Washers (6)
l - Screws (6) – 1/2 in. (12mm)

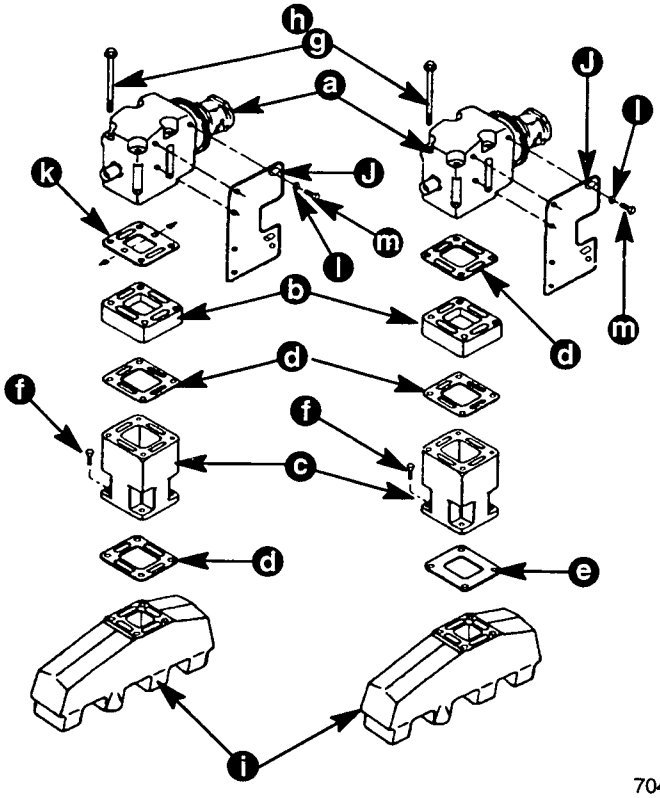


70482

Standard Cooling Closed Cooling

INSTALLATION ON MODELS WITH MUFFLERS

a - Exhaust Elbow [Cast Iron – 4 Inch (101mm)]
b - Muffler Spacer 1-1/4 in. (32mm)
c - Exhaust Riser 6 in. (152mm)
d - Open Gasket (4 slots)
e - Manifold Separator Gasket
f - Hex Head Screw (4) – 1 in. (25mm)
g - Bolt (8) – 7 in. (178mm)
h - Bolt (2) – 8 in. (203mm) (used only on remote oil filter if so equipped)
i - Exhaust Manifold
j - Riser Bracket (2)
k - Restrictor Gasket
l - Washers (6)
m - Screws (6) – 1/2 in. (12mm)



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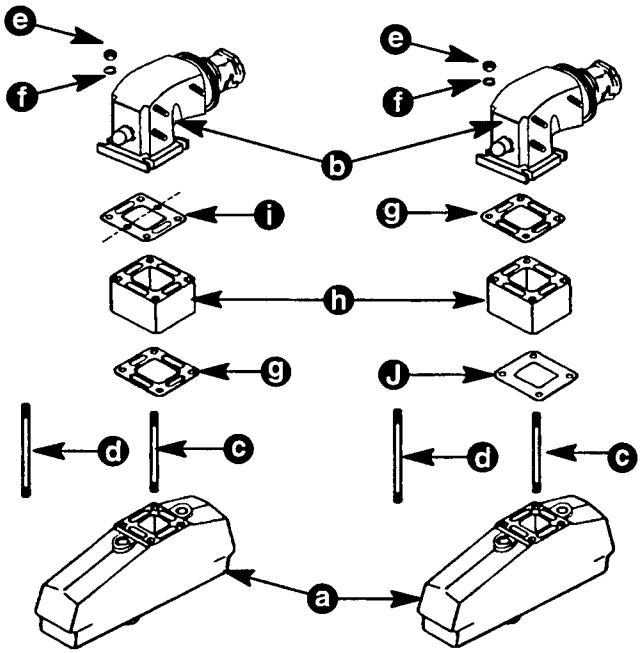
Standard Cooling Closed Cooling

Installation Diagrams

3 INCH (76mm) EXHAUST RISER KIT 93320A7

INSTALLATION ON MODELS WITHOUT MUFFLERS

a - Exhaust Manifold
b - Exhaust Elbow [Stainless Steel – 4 Inch (101mm)]
c - Stud 5 in. (8) (127mm)
d - Stud 6 in. (2) (152mm) (used only at oil filter bracket if equipped)
e - Nuts (8)
f - Washers (8)
g - Open Gasket (4 slots)
h - 3 inch (76mm) Exhaust Riser
i - Restrictor Gasket
j - Separator Gasket

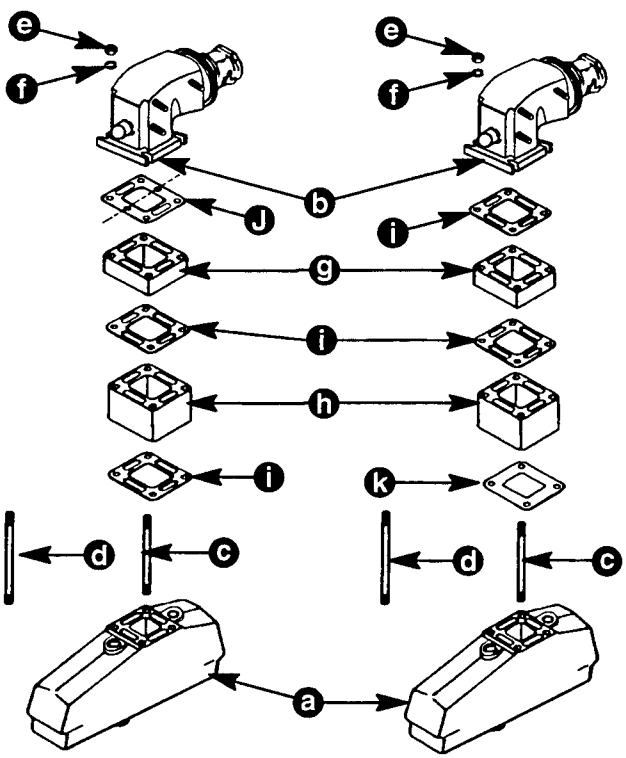


70593

Standard Cooling Closed Cooling

INSTALLATION ON MODELS WITH MUFFLERS

a - Exhaust Manifold]
b - Exhaust Elbow [Stainless Steel – 4 Inch (101mm)
c - Stud 6.5 in. (8) (165mm)
d - Stud 7.5 in. (2) (191mm) (used only at oil filter bracket if equipped)
e - Nuts (8)
f - Washers (8)
g - 1-1/4 inch (32mm) Muffler Spacer
h - 3 in. (76mm) Exhaust Riser
i - Open Gasket (4 slots)
j - Restrictor Gasket
k - Separator Gasket



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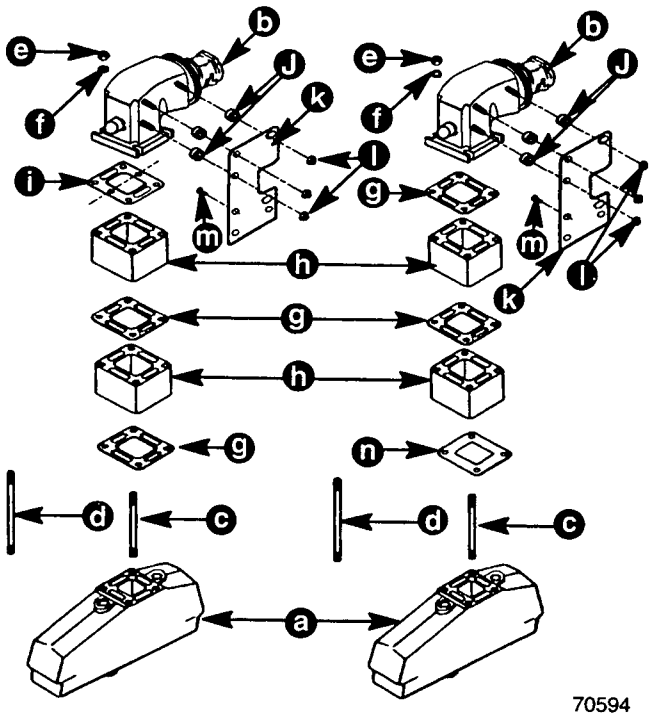
Standard Cooling Closed Cooling

Installation Diagrams

6 INCH (152mm) EXHAUST RISER KIT 93322A5

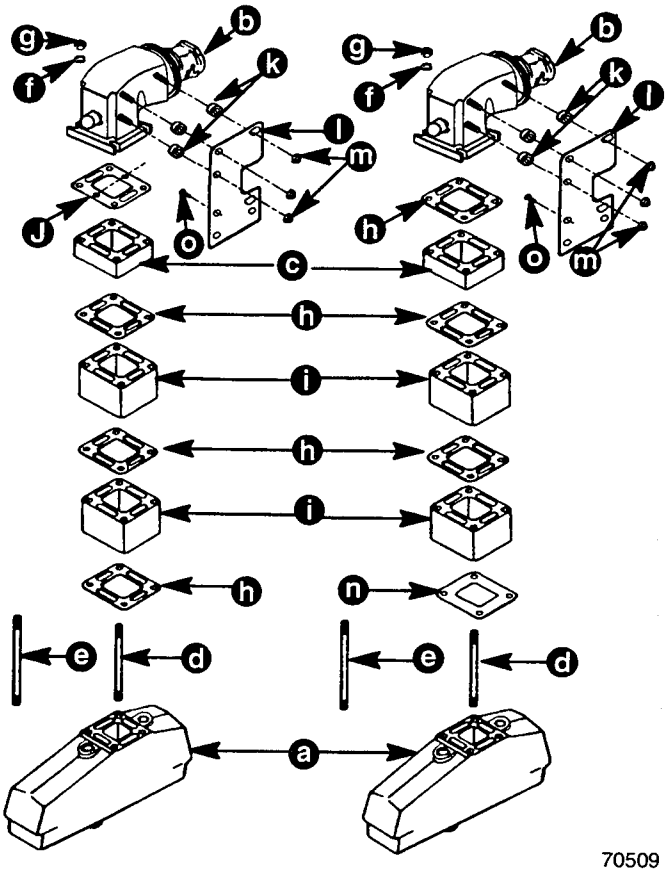
INSTALLATION ON MODELS WITHOUT MUFFLERS



Standard Cooling Closed Cooling

a - Exhaust Manifold
b - Exhaust Elbow [Stainless Steel – 4 Inch (101mm)]
c - Stud 8 inch (8) (203 mm)
d - Stud 9 3/8 inch (2) (238 mm) (used only at remote oil filter bracket if equipped)
e - Nuts (8)
f - Washers (8)
g - Open Gasket (4 slots)
h - Exhaust Riser 3 inch (76 mm)
i - Restrictor Gasket
j - Spacers (3)
k - Riser Bracket (2)
l - Nuts (6)
m - Screws (6) 3/4 inch (20 mm)
n – Separator Gasket

INSTALLATION ON MODELS WITH MUFFLERS



Standard Cooling Closed Cooling

a - Exhaust Manifold
b - Exhaust Elbow [Stainless Steel – 4 Inch (101mm)]
c - Riser 1 1/4 inch (32 mm)Height
d - Stud (8) 9-3/8 inch (238 mm)
e - Stud (2) 10-3/8 inch (264 mm) (used only on remote oil filter if equipped)
f - Washers (8)
g - Nuts (8)
h - Open Gasket
i - 3 inch (76 mm) Exhaust Riser
j - Restrictor Gasket
k - Spacers (3)
l - Riser Bracket (2)
m - Nuts (6)
n - Separator Gasket
o - Screws (6)

Special Instructions for on MCM 454 Magnum, 502 Magnum and MIE 8.2L With Front Mounted Closed Cooling System

Engine Preparation and Parts Removal

NOTE: Refer to SECTION 6B - Closed Cooling Models, if additional information and/or Water Flow Diagrams may be useful.

⚠CAUTION

If engine has been in service exhaust elbows and manifolds must be drained to prevent water from entering combustion chambers.

1. Drain exhaust elbows and exhaust manifolds.
2. Remove any items attached to the elbows on the engine and carefully lay them aside. Remember their positioning for reassembly later.
3. Remove fasteners retaining exhaust elbows and risers to manifolds and retain. Remove exhaust elbows.
4. Remove and discard old gaskets. Clean gasket mating surfaces on elbows, manifolds and risers.

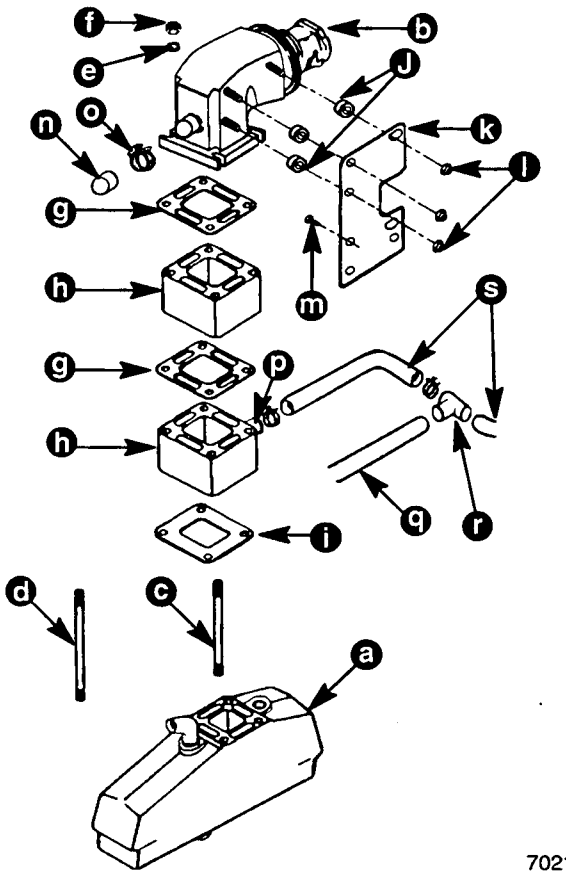
Replacement Instructions

IMPORTANT: The hoses supplied in kit or as replacement, for connection between heat exchanger and "T"-fitting, must be cut to appropriate length.

⚠CAUTION

If engine is equipped with closed cooling, MANIFOLD SEPARATOR GASKET MUST BE INSTALLED ONLY ON EXHAUST MANIFOLD. Failure to install separator gaskets on exhaust manifolds, or to install in a location other than shown, will result in severe engine damage.

1. Install gaskets between risers as shown. (NOTE: On 3 in. (76mm) riser applications only one riser per side will be present.) Be certain straight fittings on lowest riser are pointing toward flywheel end of engine. Torque fasteners in a diagonal pattern, to 23-32 lb. ft. (32-43 N.m).
2. Install "Block-Off Plug(s)" to cast fittings in elbows using hose clamps. Tighten clamps securely.
3. Connect port and starboard hoses from "T"-Fitting to straight fittings on risers (lowest riser when equipped with two 3 in. (76mm) per side to create 6 in. (152mm) rise) using hose clamps. Tighten clamps securely.
4. Install appropriate Exhaust Extension (See "Additional Kits:") for MCM Models. Tighten hose clamps securely.



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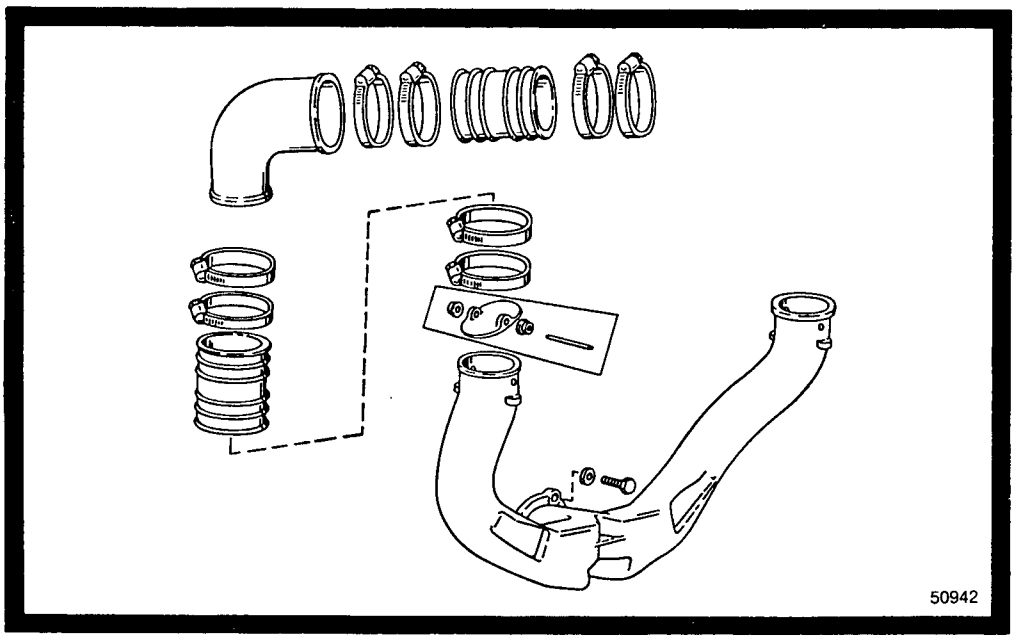
a - Exhaust Manifold
b - Exhaust Elbow
c - Stud (8) 8 inch (203 mm)
d - Stud (2) 9-3/8 inch) (238 mm) (used only on remote oil filter bracket if equipped)
e - Washers (8)
f - Nuts (8)
g - Open Gasket (4 slots)
h - 3 inch (76mm) Exhaust Riser [Two Per Side For 6 in. (152mm) Riser Kits]
i - Manifold Separator Gasket (Installed ONLY on Exhaust Manifold)
j - Spacers (3)
k - Riser Bracket
l - Nuts (6)
m - Screws (6)
n - Block-off Plug (2)
o - Clamp (2)
p - Straight Hose Coupling (2) 3/4 inch (19mm)
q - Hose [19 1/2 inch (495 mm)] "T"-Fitting-to-Heat Exchanger
r - "T"-Fitting
s - "T"-Fitting -to-Riser Straight Fittings (Only One Shown Entirely, Both Similar)

6 Inch (152mm) Riser Components Shown [3 In. (76mm) Similar]

EXHAUST SYSTEM



EXHAUST COLLECTORS

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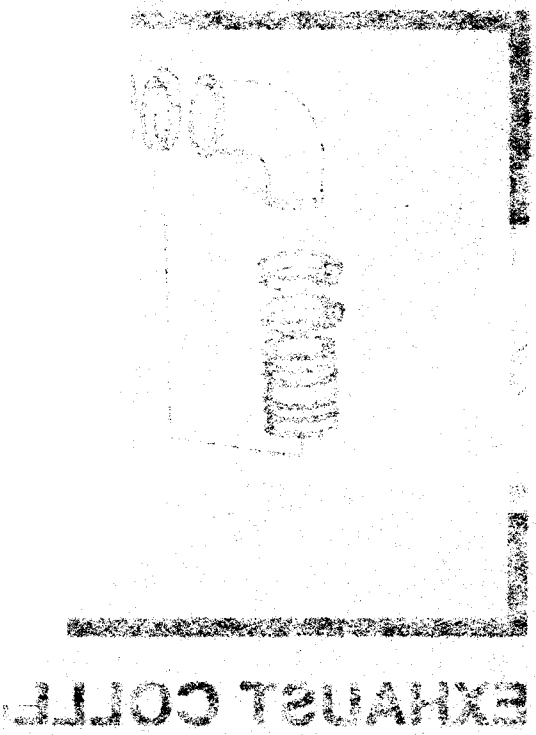


Torque Specifications

Fastener Location	Lb. Ft. (N·m)
Block Off Plate	20-25 (27-34)
Exhaust Pipe to Gimbal Housing	20-25 (27-34)
Exhaust Pipe to Tee Pipe	20-25 (27-34)
Hose Clamps	Securely
Tee Pipe to Gimbal Housing	20-25 (27-34)
Upper Exhaust Pipe to Lower Exhaust Pipe	20-25 (27-34)
Water Shutter Screw/Nut	Securely
Exhaust Elbow	20-25 (27-34)
Air Pump Mount	Securely
Muffler End Plate	Securely
Mode Switch	Securely

Sealants

92-86166	Quicksilver Bellows Adhesive
92-34227	Quicksilver Perfect Seal
92-25711-1	Liquid Neoprene
92-25234	Sound Blanket Glue

Lubricants and Adhesives

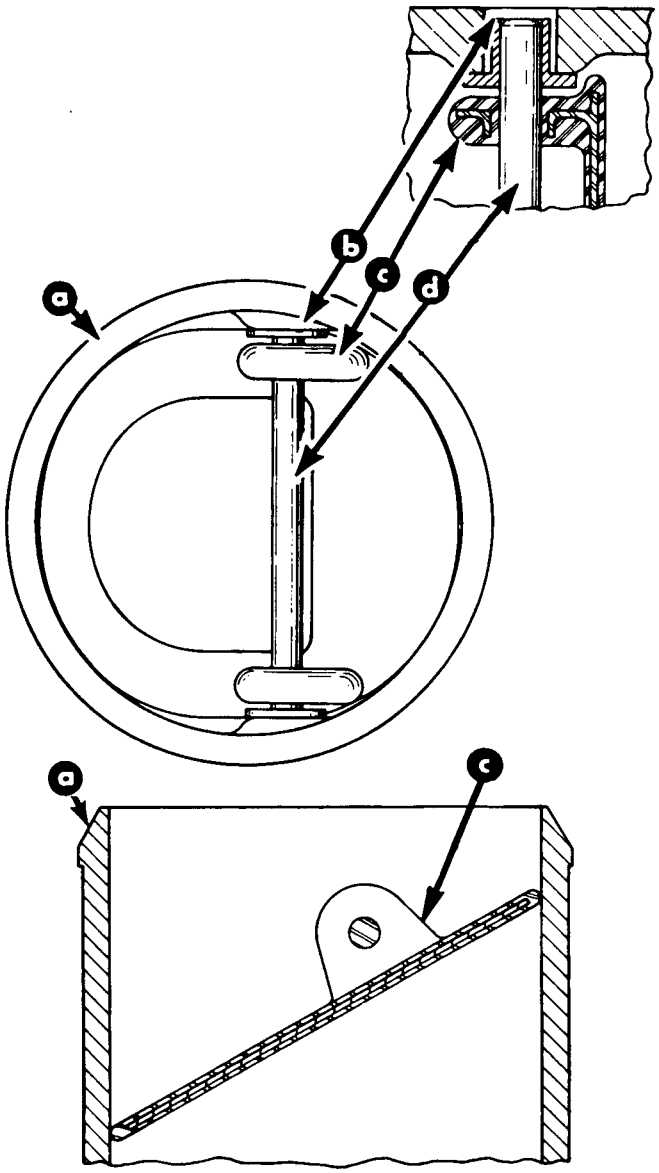
92-86154A1	2-4-C Marine Lubricant
92-59328-1	Loctite No. 35
92-59327-1	Loctite Primer

Alpha One and Bravo One and Two Drive

Shutter Replacement

IMPORTANT: Engine does not have to be removed to change shutters.

1. Loosen clamps and remove exhaust pipe elbow and exhaust hose.
2. Replace water shutter as shown.
3. Reinstall pipe elbow and hose. Tighten clamps securely.

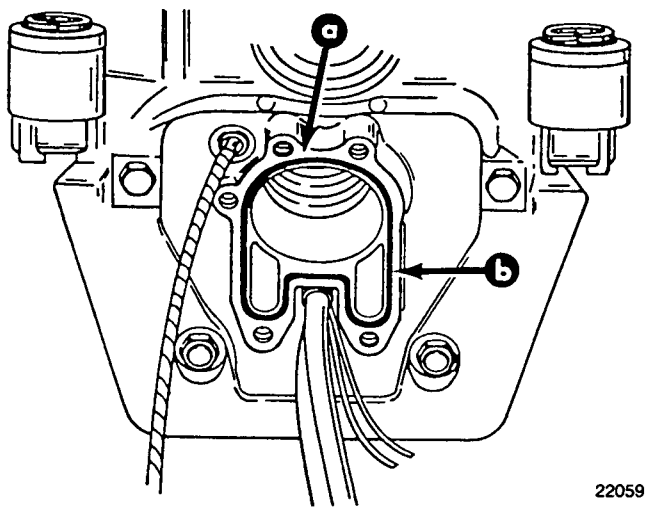


a - Top of Pipe
b - Shoulder Bushing
c - Water Shutter - Install as Shown
d - Shaft

Component Replacement

To replace any component(s) in exhaust system, the following must be adhered to:

- All mating joint surfaces must be clean.
- O-ring must remain in groove to properly seal joint to prevent leakage.
- Torque all screws 20-25 lb. ft. (27-34 N·m).
- Tighten all clamps securely.



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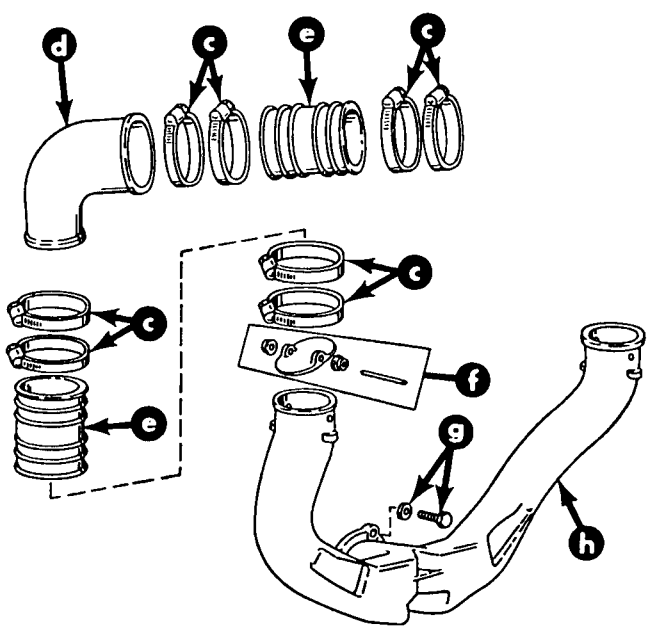

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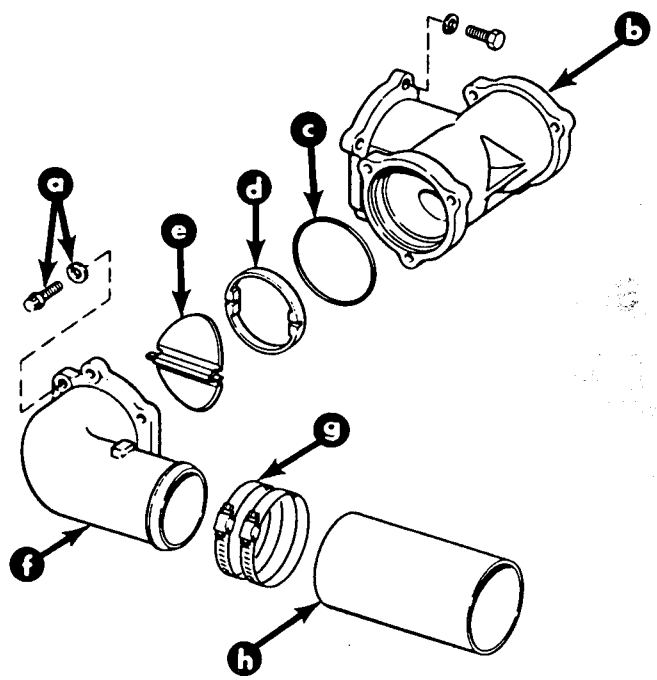
a - Mating Surface
b - O-ring
c - Clamps
d - Exhaust Pipe Elbow
e - Exhaust Hose
f - Water Shutters
g - Screws and Lockwashers - Torque to 20-25 Lb. Ft. (27 - 34 N·m)
h - Exhaust Pipe

Alpha One Driveshaft Extension

Shutter Replacement

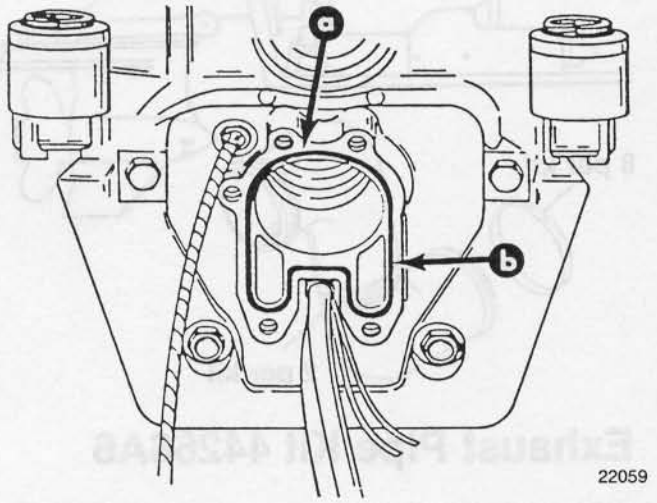
1. Loosen hose clamps on exhaust hose and remove screws and lockwashers.
2. Remove exhaust pipe elbow.
3. Remove water shutter, then retainer from tee pipe.
4. Install retainer, and shutter as shown.
5. Make sure mating surfaces are clean and O-ring is in groove.
6. Reinstall exhaust pipe elbow with screws and lockwashers. Torque screws to 20-25 lb. ft. (27-34 N·m). Be certain that O-ring remains seated in groove, properly sealing joint to prevent leakage.
7. Tighten clamps securely.



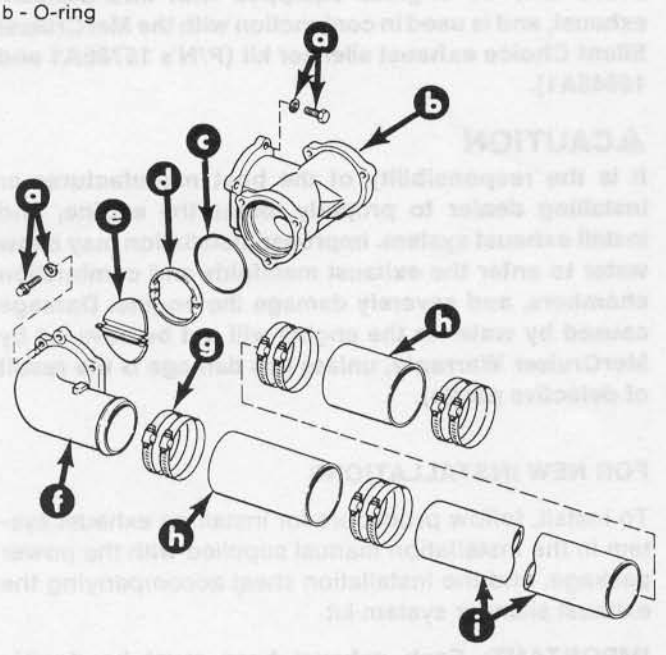
a - Screws and Lockwashers - Torque to 20-25 Lb. Ft. (27-34 N·m)
b - Tee Pipe
c - O-ring
d - Retainer - Slots Facing Out
e - Water Shutter - Opens Toward Inside of Tee Pipe
f - Exhaust Pipe Elbow
g - Clamps
h - Exhaust Hose

Component Replacement

1. To replace any componet(s) in exhaust system, the following must be adhered to:
   - All mating joint surfaces must be clean.
   - O-rings must remain in groove to properly seal joints to prevent leakage.
   - Torque all screws to 20-25 lb. ft. (27-34 N·m).
   - Tighten all clamps securely.

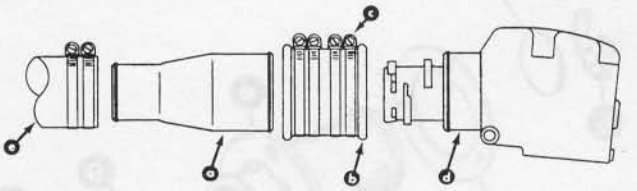


a - Gimbal Housing Mating Surface
b - O-ring



a - Screws and Lockwashers - Torque to 20-25 Lb. Ft. (27-34 N·m)
b - Tee Pipe
c - O-ring
d - Retainer - Slots Facing Out
e - Water Shutter - Opens Toward Inside of Tee Pipe
f - Exhaust Pipe Elbow
g - Clamps
h - Exhaust Hose
i - Exhaust Tube

4 in. to 3 in. Exhaust Reducer Kit 44349A1

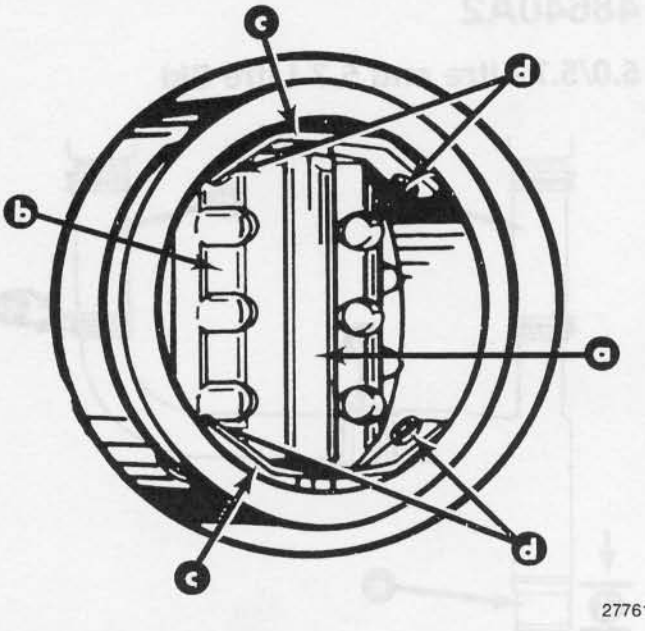


a - Reducer
b - Exhaust Tube
c - Hose Clamp
d - Exhaust Elbow
e - Exhaust Hose

Thru Transom Exhaust Flange

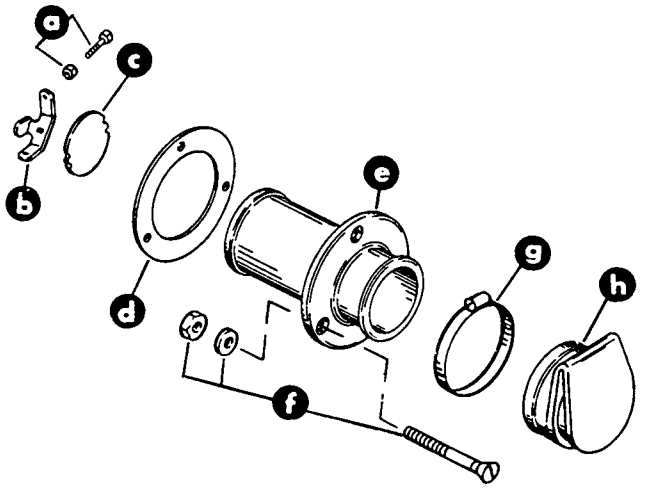
Shutter Replacement

1. Remove exhaust hose clamps, then hose.
2. Chisel rivets away from both support members.
3. Install new shutter as shown. Tighten screws and nut securely.
4. Reinstall exhaust hose. Tighten clamps securely.



a - Shutter Hinge
b - Water Shutter - Opens Toward Outside of Boat
c - Support Member
d - Rivets (4)

Component Replacment



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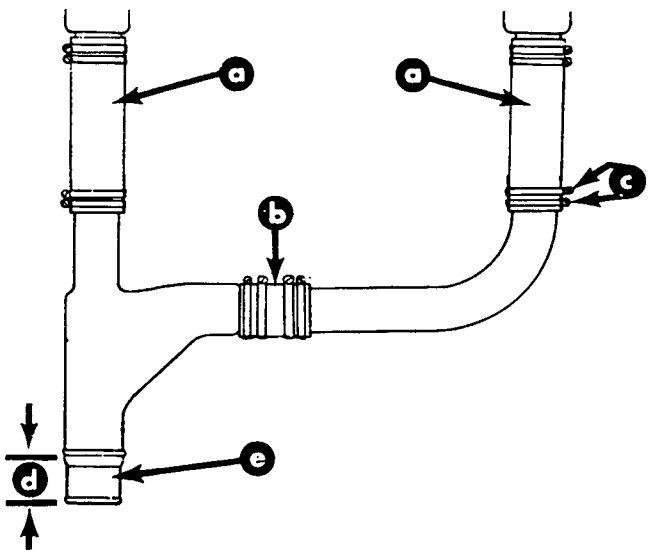
a - Screw and Nut (4)
b - Support Member
c - Water Shutter
d - Gasket
e - Exhaust Flange
f - Screws, Washers and Nuts (3)
g - Clamp
h - Cover ("Flapper")

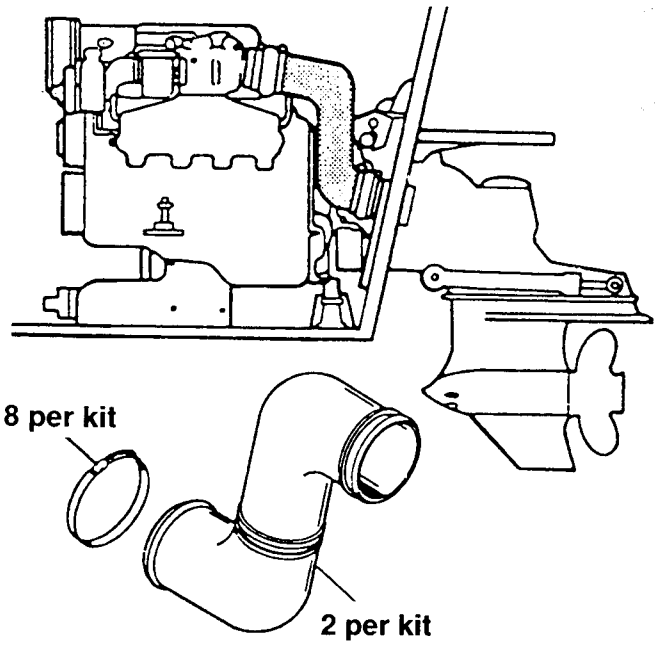
MIE Single Exhaust Kit 48640A2

5.0/5.7 Litre and 5.7 Litre Ski



a - Hose - Cut to Fit
b - Hose - 4 In. (102mm) Long
c - Clamps - 2 At Each Connection, Tighten Securely
d - Cut 2-3/8 In. (60mm) From End of "Y" Pipe to Allow Use of 4 In. (102mm) Exhaust Hose
e - Connect to Thru Transom Exhaust Hose

Below Swim Platform Exhaust Pipe Kit 18563A1



Exhaust Pipe Kit 44266A6

IMPORTANT: This kit is used only on Alpha One or Bravo One V8 engines equipped with thru-transom exhaust, and is used in conjunction with the MerCruiser Silent Choice exhaust silencer kit (P/N's 15786A1 and 16645A1).

⚠CAUTION

It is the responsibility of the boat manufacturer or installing dealer to properly locate the engine, and install exhaust system. Improper installation may allow water to enter the exhaust manifolds and combustion chambers, and severely damage the engine. Damage caused by water in the engine will not be covered by MerCruiser Warranty, unless this damage is the result of defective part(s).

FOR NEW INSTALLATIONS

To install, follow procedure for installing exhaust system in the installation manual supplied with the power package, and the installation sheet accompanying the exhaust silencer system kit.

IMPORTANT: Each exhaust hose must be double clamped at each connection, and the hose clamps tightened securely.

⚠CAUTION

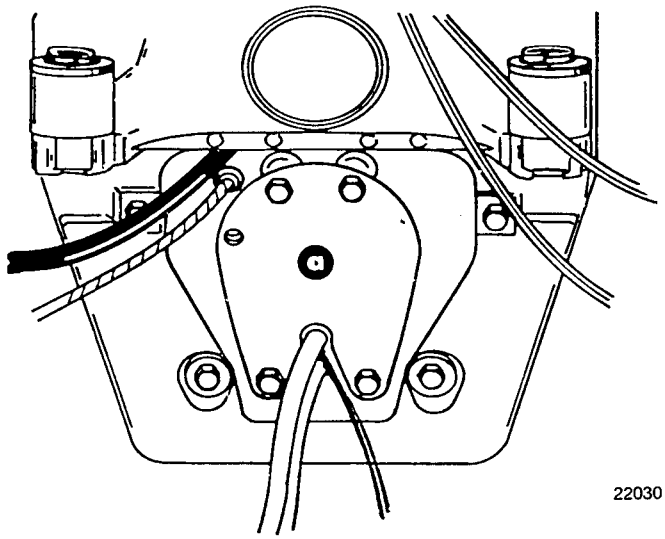
On Bravo One 454 Magnum installations: if an exhaust bellow is installed between gimbal housing and stern drive it must be removed and replaced by an exhaust tube, included in this kit. Follow instructions accompanying the MerCruiser Silent Choice kit.

CONVERTING EXISTING THRU-TRANSOM INSTALLATIONS

1A. Remove stern drive unit, following Stern Drive Service Manual procedure applicable to the installation.

1B. Remove engine, following engine service manual procedure applicable to the installation.

2. Remove block-off plate (a).



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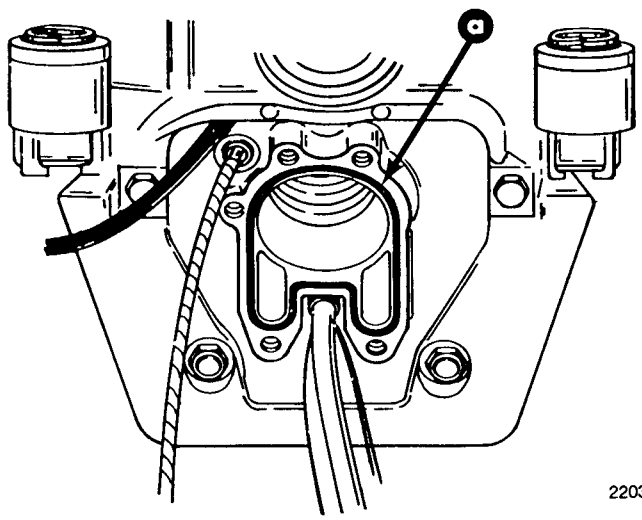
3. Check that O-ring seal (a) is pliant (not hardened), and is above surface of casting. Replace when necessary. Secure O-ring in groove with Sound Blanket Glue (P/N 92-25234-1). Remove excess glue from external surfaces immediately — be careful not to disturb O-ring.



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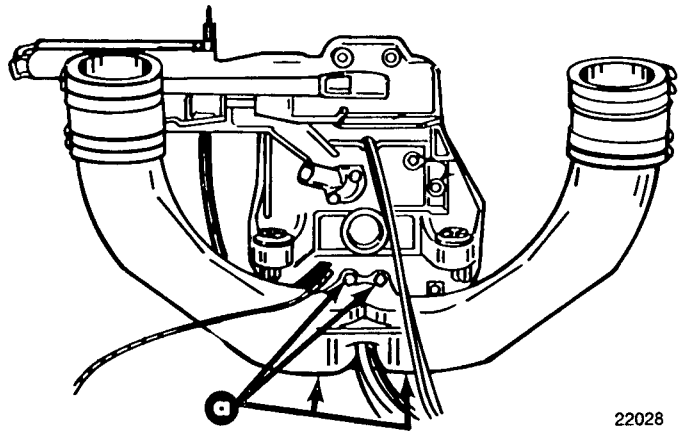
4. Attach exhaust pipe, as shown. Tighten screws (a) to 20-25 lb. ft. (27-34 N·m).



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5. Reinstall and align engine, following service manual procedure.

6. Reinstall drive unit following service manual procedure.

ALPHA ONE MODELS ONLY:

IMPORTANT: On Alpha One thru-transom installations only, the exhaust bellows/tube (between the gimbal housing and drive unit) has been removed. THIS MUST BE REINSTALLED.

Install exhaust bellows/tube (lower gimbal housing to drive unit), following procedure in MerCruiser Stern Drive Unit Service Manual (P/N 90-12934 Section 4A).

7. Recheck shift adjustment following procedure in Stern Drive Service Manual.

8. Complete installation of exhaust silencer system, following procedures supplied with that kit.

Silent Choice Exhaust Silencer System 15786A2 & 16645A2

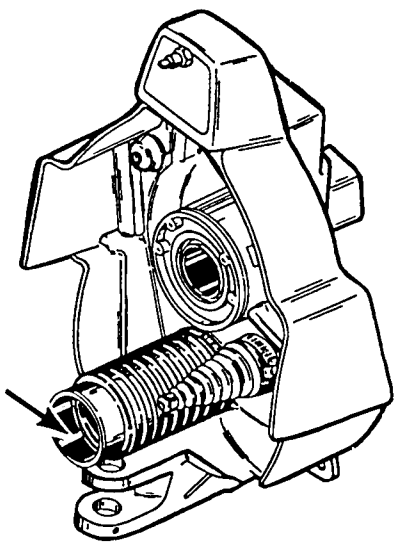
IMPORTANT: This kit may be used on any Alpha One or Bravo One V8 installation, with a 4 in. (102mm) exhaust system. Kit cannot be used on engines with 3 in. (76mm) or 6 in. (152mm) exhaust risers.

If engine is equipped with thru-prop exhaust, a thru-transom kit [4 in. (102mm)], exhaust bellows (2), and bellows hose clamps (8), are required.

If engine is equipped with thru-transom exhaust, an exhaust pipe kit (P/N 44266A6) is required, containing the exhaust pipe and necessary parts.

IMPORTANT: On existing ALPHA ONE thru-transom installations, the gimbal housing-to-stern drive exhaust at bellows/tube has been removed. Replace the bellows (tube on Alpha One 454 Magnum), following the procedure in "Stern Drive Service Manual" (90-12934 — Section 4A).

IMPORTANT: Refer to Section 1C for troubleshooting.



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⚠CAUTION

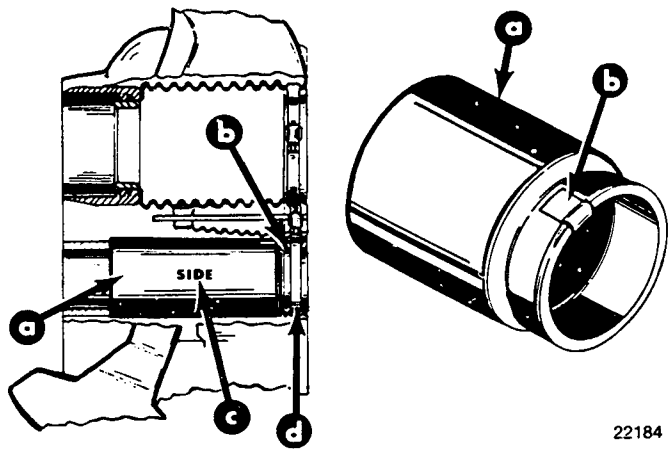
Bravo One 454 Magnum Installations: if drive unit is equipped with a bellows rather than an exhaust tube, bellows MUST be removed and replaced with tube (from "Exhaust Pipe Kit"). Failure to do this can result in damage to the U-joint bellows and substantial water leakage into the boat.

BRAVO ONE EXHAUST TUBE INSTALLATION (Models Equipped with Bellows)

⚠CAUTION

Exhaust tube clamp may corrode if grounding clip is not installed.

1. Raise unit to full "up" position.
2. Remove exhaust bellows; clean mounting flanges with lacquer thinner and sandpaper.
3. Install exhaust tube (P/N 78458) with grounding clip, as shown.
4. Clamp, as shown — tighten securely. No bellows adhesive is required.



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a - Exhaust Tube
b - Top End of Bellows/Ground Clip - Must Be on Top of Mounting Flange; Short End with 2 Bumps Inward
c - "Side" Markings - Position Tube with these Markings to the Right and Left
d - Clamp - Tighten Securely

INSTALLATION OF TRANSOM PLATE, EXHAUST PIPE, ENGINE, and DRIVE: refer to installation manual supplied with power package.

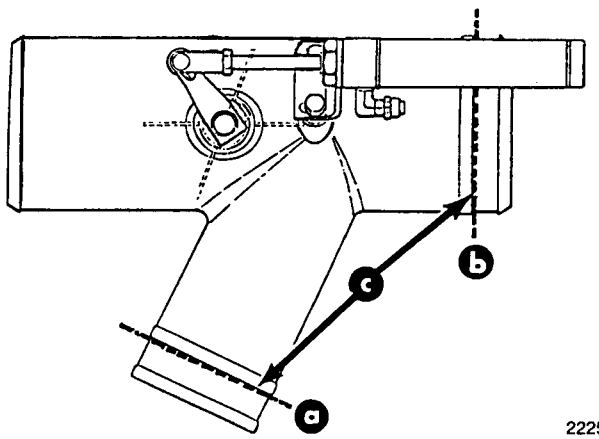
⚠CAUTION

It is the responsibility of the boat manufacturer or installing dealer to properly locate the engine, and install exhaust system. Improper installation may allow water to enter the exhaust manifolds and combustion chambers, and severely damage the engine. Damage caused by water in the engine will not be covered by MerCruiser Warranty, unless this damage is the result of defective part(s).

MODIFYING EXHAUST SILENCER VALVE FOR USE ON 305/350 CID (5.0/5.7) ALPHA ONE ENGINES

1. Cut off casting, as shown, along outer edge of inner weit (a), on both starboard and port silencer valves.
2. Cut off casting, as shown, along outer edge of inner welt (b), on starboard silencer valve, only.

IMPORTANT: No modifications are required when installing silencer valves on 454 CID (7.4 L) Alpha One or Bravo One engines.



22255

a - Cut at this Location for 305/350 (5.0/5.7L) CID Installations.
b - Cut at this Location for 305/350 (5.0/5.7L) Starboard Side Installation
c - Prime and Paint all Exposed (cut) Surfaces

3. Transom Cutouts:

   a. **New Installations** - follow procedure and observe specifications in power package installation manual for "Transom Assembly Installation."

      1. After cutting gimbal housing hole in transom, cut out correct silencer system template on line "a", and align template with transom cutout.
      2. Align horizontal and vertical centerlines. Tape template into place.
      3. Mark centers on correct holes "c" or "d", and cut out holes using specified hole saw.

IMPORTANT: Seal inside edge of cutout openings with a suitable sealant to prevent water absorption and deterioration of transom.

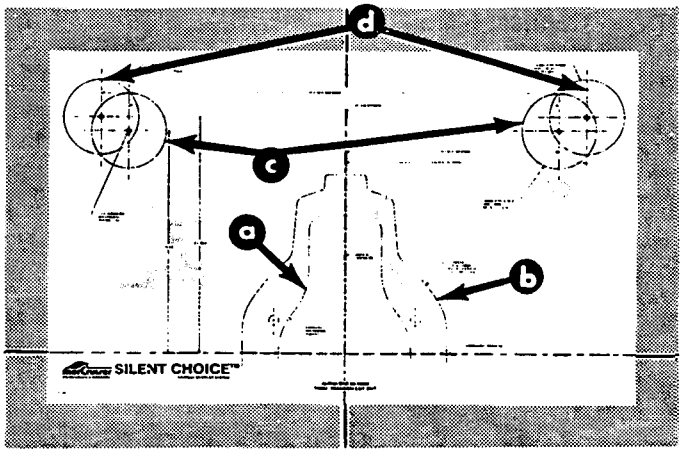
      4. Install thru-transom exhaust fittings.

   b. **Existing Installations:**

      1. Cut out template on line "b".
      2. Position template cutout over gimbal housing.
      3. Align horizontal and vertical centerlines. Tape template into place.
      4. Mark centers on correct holes "c" or "d," and cut out holes using specified hole saw.

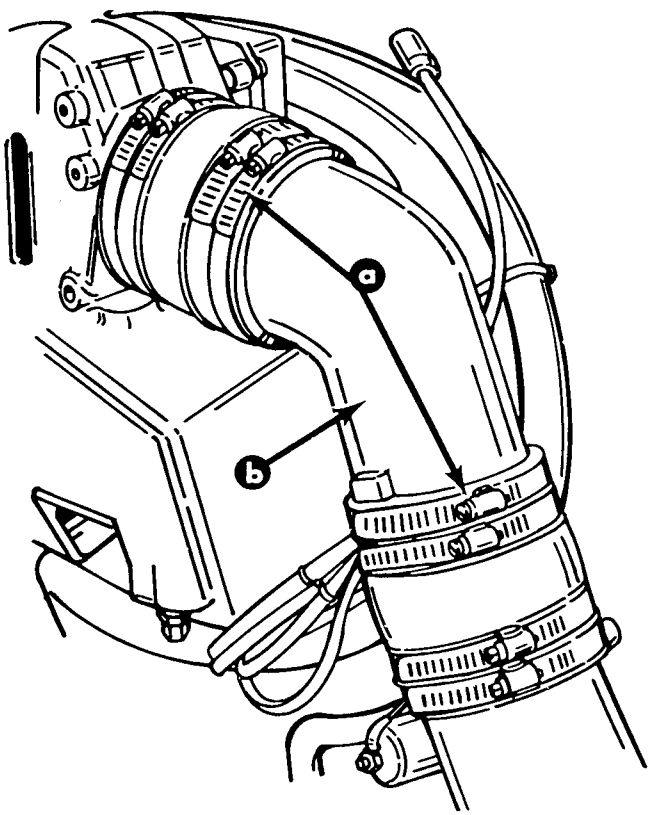
IMPORTANT: Seal inside edge of cutout openings with a suitable sealant to prevent water absorption and deterioration of transom.

      5. Install thru-transom exhaust fittings.



22256

4. Install transom plate and exhaust pipe following Installation Manual procedures.
5. Remove intermediate exhaust pipe (b) from engine — retain clamps and bellows (a).

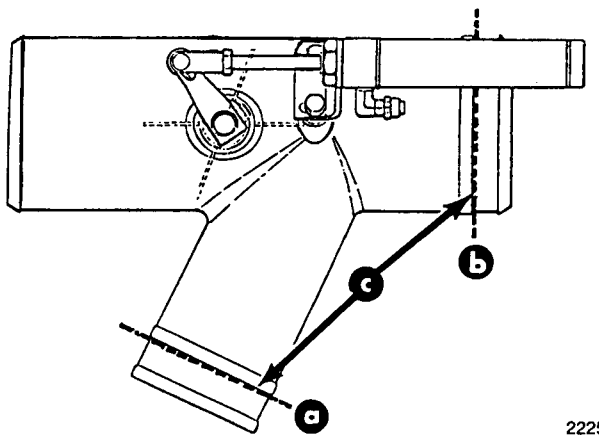


22059

MODIFYING EXHAUST SILENCER VALVE FOR USE ON 305/350 CID (5.0/5.7) ALPHA ONE ENGINES

1. Cut off casting, as shown, along outer edge of inner weit (a), on both starboard and port silencer valves.
2. Cut off casting, as shown, along outer edge of inner welt (b), on starboard silencer valve, only.

IMPORTANT: No modifications are required when installing silencer valves on 454 CID (7.4 L) Alpha One or Bravo One engines.



22255

a - Cut at this Location for 305/350 (5.0/5.7L) CID Installations.
b - Cut at this Location for 305/350 (5.0/5.7L) Starboard Side Installation
c - Prime and Paint all Exposed (cut) Surfaces

3. Transom Cutouts:

   a. **New Installations** - follow procedure and observe specifications in power package installation manual for "Transom Assembly Installation."

      1. After cutting gimbal housing hole in transom, cut out correct silencer system template on line "a", and align template with transom cutout.
      2. Align horizontal and vertical centerlines. Tape template into place.
      3. Mark centers on correct holes "c" or "d", and cut out holes using specified hole saw.

IMPORTANT: Seal inside edge of cutout openings with a suitable sealant to prevent water absorption and deterioration of transom.

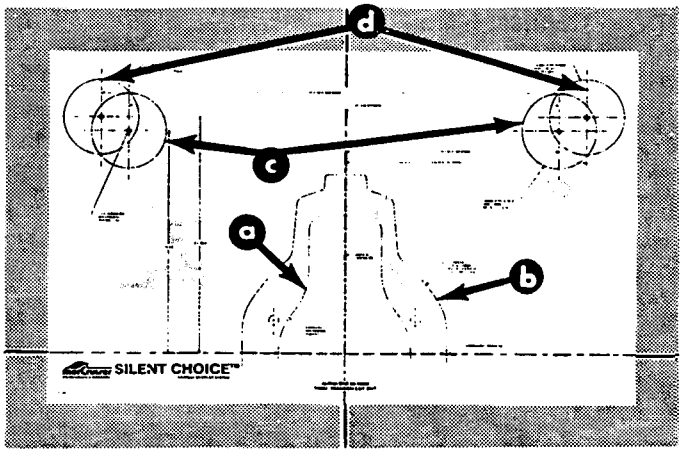
      4. Install thru-transom exhaust fittings.

   b. **Existing Installations:**

      1. Cut out template on line "b".
      2. Position template cutout over gimbal housing.
      3. Align horizontal and vertical centerlines. Tape template into place.
      4. Mark centers on correct holes "c" or "d," and cut out holes using specified hole saw.

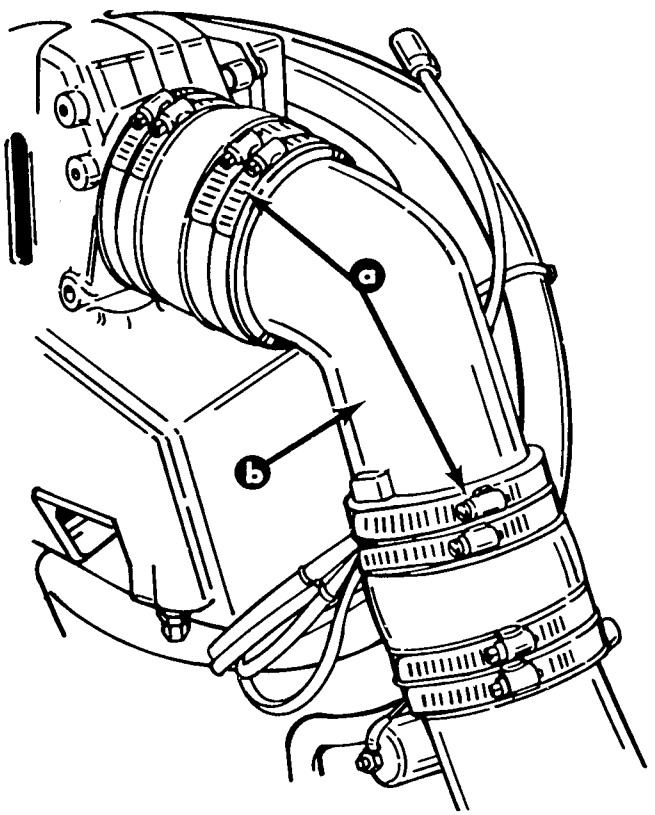
IMPORTANT: Seal inside edge of cutout openings with a suitable sealant to prevent water absorption and deterioration of transom.

      5. Install thru-transom exhaust fittings.



22256

4. Install transom plate and exhaust pipe following Installation Manual procedures.
5. Remove intermediate exhaust pipe (b) from engine — retain clamps and bellows (a).



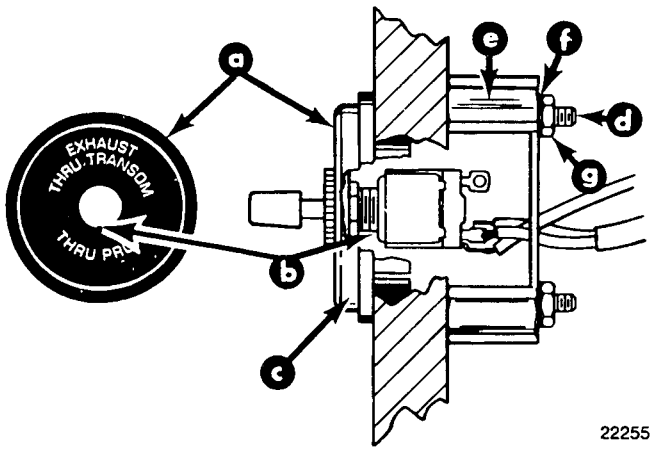
22059

ELECTRICAL CONNECTIONS MODE SWITCH INSTALLATION

1. Route mode switch and wiring harness from air pump to dash, making sure that harness does not rub or get pinched. Fasten harness to boat at least once every 18 in. (460mm), with appropriate fasteners.

IMPORTANT: Before cutting hole (in next step), check area directly behind dashboard for adequate clearance.

2. Cut a 2-1/8 in. (54mm) diameter hole thru dashboard, at desired location.
3. Thread two studs (d) all the way into holes on backside of mode switch bezel; then, position bezel in hole with key down, and secure with mounting clamp (e), flat washers (f) and nuts (g). Tighten nuts securely, but be careful not to crack mounting clamp.
4. Align keyway (b) in mode switch with key (b) in bezel, and install switch and decal (a) into bezel (c). Secure with nut, as shown.



22255

5. Connect purple wire (d) to "I" terminal [terminal with purple or white wire(s) attached to it] on one of the adjacent gauges, or to any 12 volt (+) source on switched side of ignition switch.

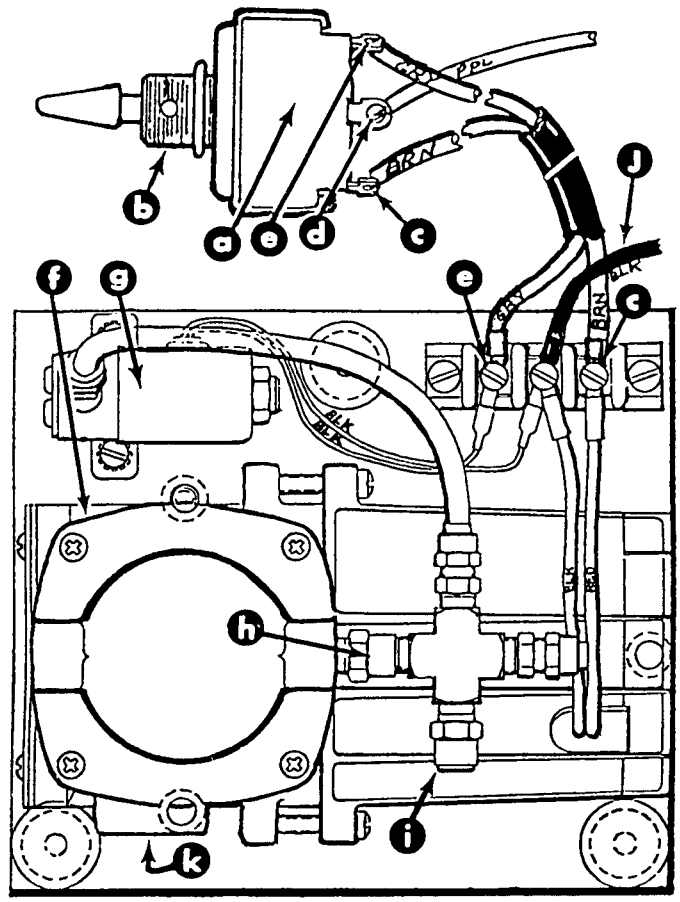
⚠CAUTION

If instrumentation and/or wiring other than that of Mercury Marine is used, a 20 amp inline fuse in purple wire (d) going to 12 volt (+) source or establish that circuit is already fused at 20 amps.

IMPORTANT: After electrical connections are secure, coat each terminal/connection with Liquid Neoprene.

MAINTENANCE

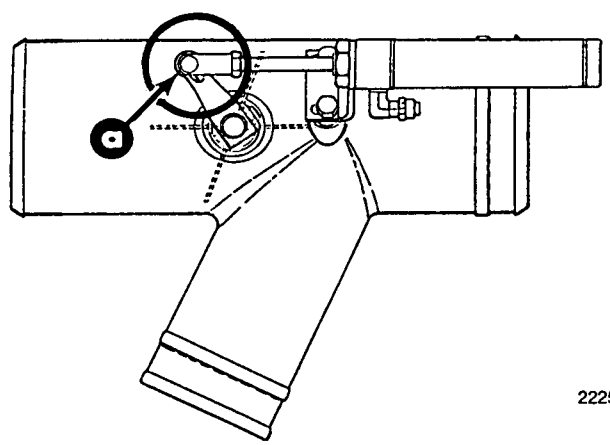
1. Air Intake Filter (P/N 32-17272) must be checked once each year. If filter is clogged or partially clogged, replace. The filter pad is glued-in, and may be removed with a needle-nose pliers. Clean surface in casting, apply a single dot of Sound Blanket Glue (3M Glue EC 887) - Quicksilver P/N 92-25234, to center of casting, and install new filter. Be careful not to coat filter or clog air intake holes with adhesive.



22255

a - Mode Switch
b - Keyway - Install in "Down" Position
c - Brown Wire to Terminal 3 - Activates Compressor
d - Purple Wire - 12 Volt; Connect to 12 Volt Source in Control Panel Area
e - Grey Wire to Terminal 1 - Activates Solenoid
f - Air Pump
g - Solenoid
h - Check Valve
i - Relief Valve - 30 PSI
j - 2 ft. (610mm) Ground Wire - Connect to Terminal 2 - Must Be Grounded to Engine
k - Air Intake Filter

2. Lubricate air cylinder-to-silencer pipe flapper per clevis and pin, as needed, with 2-4-C Marine Lubricant.



22255

a - Lubricate Clevis and Pin with 2-4-C Marine Lubricant

Exhaust Muffler Kit 42-17705A3

This muffler, designed for use on all V8 engines with Plus Power™ exhaust systems (4 in., 7 degrees downward outlets), requires the installation of 1-1/4 in. (32mm) exhaust elbow risers, which are included in this kit.

IMPORTANT: If a thru-transom exhaust kit other than the one from Mercury Marine is used, the exhaust kit must be equipped with internal shutters and external flappers.

⚠CAUTION

It is the responsibility of the boat manufacturer or installing dealer to properly locate the engine and install exhaust system. Improper installation may allow water to enter the exhaust manifolds and combustion chambers, and severely damage the engine. Damage caused by water in the engine will not be covered by the MerCruiser Warranty, unless this damage is the result of defective part(s).

New Installations

IMPORTANT: If 3 or 6 in. (76 or 152mm) manifold risers are used, raise thru-transom exhaust fitting hole by 3 or 6 inches, as required.

1. Prepare transom and cut thru-transom holes for exhaust shutter, following instructions accompanying that kit. Locate holes for thru-transom fittings using template provided.

IMPORTANT: Seal inside edge of cutout openings with a suitable sealant to prevent water absorption and deterioration of transom.

2. Remove 4 bolts from each exhaust elbow and discard, and remove elbows from manifolds.
3. Remove gaskets and discard. Clean hose mating surfaces thoroughly.
4. Apply Loctite 35 with primer to manifold end of replacement studs. Install replacement studs; tighten studs securely.

NOTE: If remote oil filter is mounted atop the exhaust elbow, the two largest replacement studs must be installed in those two mounting holes.

NOTE: If 3 or 6 in. risers are used, one of the following additional accessory stud or bolt kits must be used:

3 in. risers - 17833A2 (Studs)
6 in. risers - 17833A3 (Bolts)

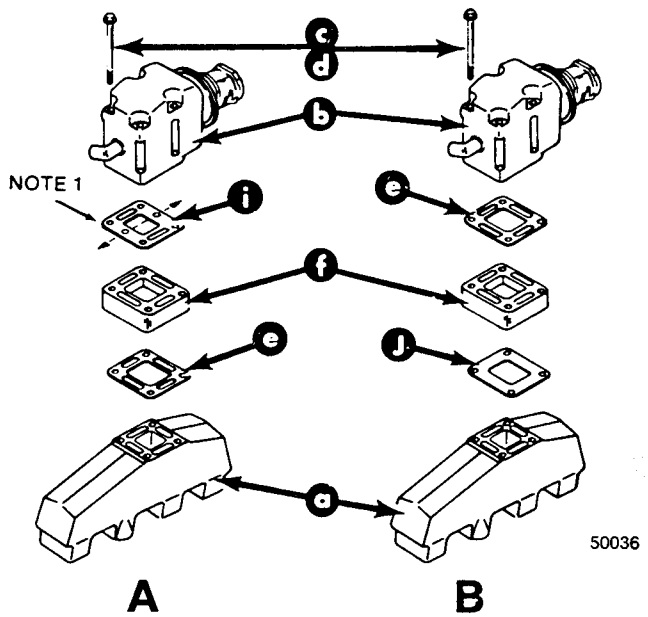
NOTE: On 3 inch riser installations, it is necessary to remove ignition module from exhaust elbow, in order to raise elbow to install on studs.

5. Install components as shown, following the applicable assembly sequence in 1A, 1B, 2A, 2B, 3A or 3B.

NOTE: Gaskets "e," only, must be lightly coated, both sides, with Perfect Seal.

1-1/4 INCH MUFFLER RISER INSTALLATION, ONLY:

IMPORTANT: Restrictor gaskets or separator gaskets must be installed in order shown.



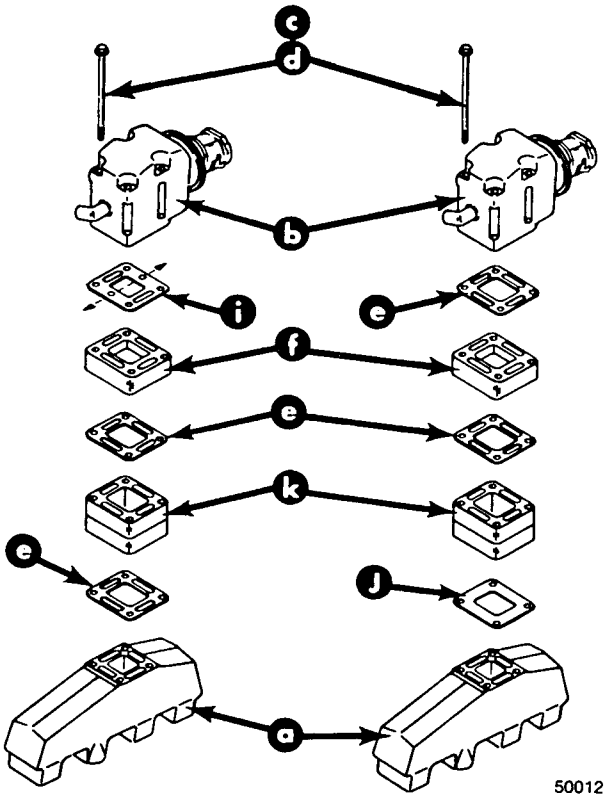
a - Exhaust Manifold
b - Exhaust Elbow
c - Bolt (4), 7 in. (178mm); Each Manifold
d - Bolt, Remote Oil Filter Bracket (2), 8 in. (203mm)
e - Gasket - Lightly Coat Both Sides with Perfect Seal
f - Riser, 1-1/4 in. (32mm) Height
g - Lockwasher (4)
h - Nut (4)
i - Restrictor Gasket
j - Separator Gasket

Figure 1.

NOTE: Drain plugs in risers face toward stern.

3 INCH RISER INSTALLATION, IF APPLICABLE

IMPORTANT: Restrictor gaskets or separator gaskets must be installed in order shown.



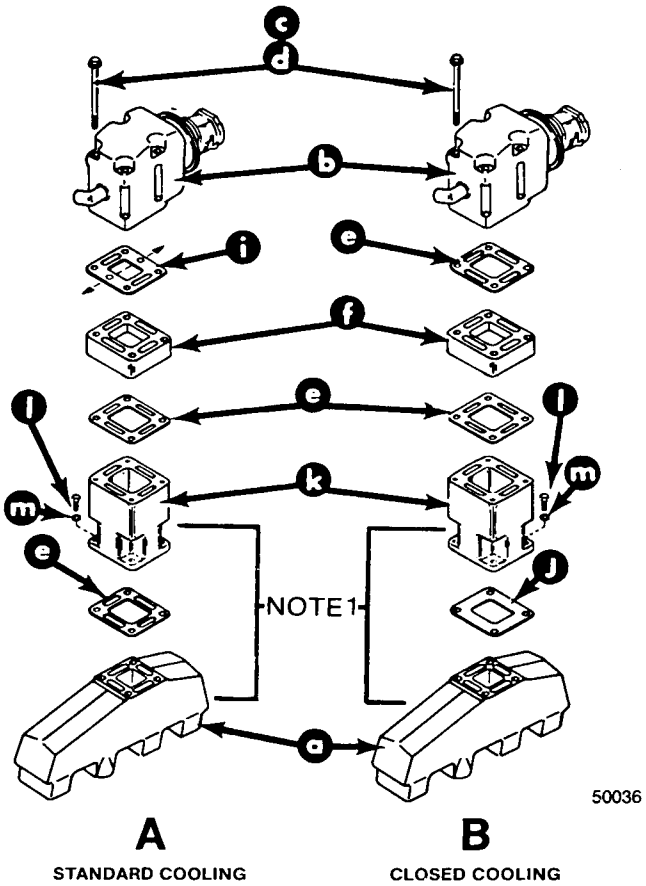
a - Exhaust Manifold
b - Exhaust Elbow
c - Stud (4), 3 in. Riser - 10.88 in. (276mm)
d - Stud, Remote Oil Filter Bracket (2), 3 in. Riser - 11.88 in. (302mm)
e - Gasket - Lightly Coat Both Sides with Perfect Seal
f - Riser, 1-1/4 in. (32mm) Height
g - Lockwasher (4)
h - Nut (4)
i - Restrictor Gasket
j - Separator Gasket
k - 3 in. (76mm) Exhaust Riser

Figure 2.

NOTE: Drain plugs in risers face toward stern.

6 INCH RISER INSTALLATION, IF APPLICABLE

IMPORTANT: Restrictor gaskets or separator gaskets must be installed in order shown.



NOTE 1: **On existing installations,** 6 in. risers are not separated from manifold. **DO NOT** remove base attaching screws, unless gasket replacement is necessary.

a - Exhaust Manifold
b - Exhaust Elbow
c - Bolt (4), 6 in. Riser - 7.00 in. (178mm)
d - Bolt, Remote Oil Filter Bracket (2), 6 in. Riser - 8.00 in. (203mm)
e - Gasket - Lightly Coat Both Sides with Perfect Seal
f - Riser, 1-1/4 in. (32mm) Height
g - Lockwasher (4)
h - Nut (4)
i - Restrictor Gasket
j - Separator Gasket
k - 6 in. (152mm) Exhaust Riser
l - Hex-Head Screw (4)
m - Lockwasher (4)

Figure 3.

NOTE: Drain plugs in risers face toward stern.

6. If 6 in. riser installation, torque base attaching screws in a diagonal pattern, to 20-25 lb. ft. (27-34 N·m).

7. After assembling riser components, and exhaust elbows are in place, position oil filter bracket, if so mounted, and attach one nut and lockwasher to each stud (bolts, on 6 in. riser); torque screws/nuts in a diagonal pattern to 20-25 lb. ft. (27-34 N·m).

8. **On 3 inch riser installations:** Reattach ignition module to exhaust elbow. Tighten securely.

NOTE: Muffler Installation Kit (Quicksilver P/N 42-17705A4) is available, and provides necessary exhaust tubes, hoses, and hose clamps.

IMPORTANT: A MOLDED exhaust tube MUST be used at exhaust elbow connection, to maintain positive separation of exhaust outlet and muffler inlet.

9. Install mufflers and exhaust tubes/hoses, as shown. (Figure 4)

10. Install exhaust outlets through transom into the exhaust hoses, following instructions in thru-transom kit.

11. Double clamp each connection; tighten each clamp securely.

Existing Installations

IMPORTANT: Exhaust elbows and manifold must be drained to prevent water from entering combustion chambers.

NOTE: On any installation using studs to secure the exhaust elbow to manifold, it is necessary to remove the ignition module if it is attached to the exhaust elbow, and then reinstalled after new components are installed. Tighten all bolts/nuts securely (torque where specified).

1. Loosen hose clamps and remove exhaust tubes/hoses between exhaust elbows and thru-transom fittings.

2. Clean hose mounting surfaces thoroughly.

3A. **NO RISER OR 3 IN. (76mm) RISER INSTALLATIONS:** Remove 4 bolts (or 4 nuts and washers) from each exhaust elbow, and discard. Remove exhaust elbows, risers if so equipped, and discard gaskets.

3B. **6 IN. (152mm) RISER INSTALLATIONS:** Remove 4 top nuts/washers from each elbow. **DO NOT remove riser base hex-head screws.** Remove each exhaust elbow, and discard gaskets.

4. Clean mating surfaces thoroughly.

5. Remove old studs, if so equipped, and discard. Apply Loctite 35 with primer to manifold end of new correct length stud, and thread into manifold. Tighten securely.

NOTE: If remote oil filter is mounted atop the exhaust elbow, the two longest replacement studs must be installed in those two stud holes.

NOTE: If 3 or 6 in. risers are used, one of the previously listed accessory stud/bolt kits must be used.

6. Select the assembly sequence which fits the installation, and reassemble. If risers are used, the 1-1/4 in. riser must be mounted between the 3 or 6 inch riser, and the exhaust elbow. Gasket(s) "e," ONLY, should be lightly coated, each side, with Perfect Seal.

NOTE: Muffler Installation Kit (Quicksilver P/N 42-17705A4) is available, and provides necessary exhaust tubes, hoses, and hose clamps.

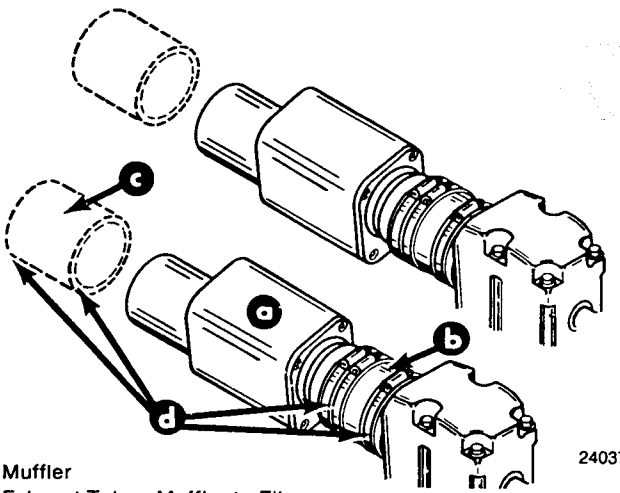
IMPORTANT: A MOLDED exhaust tube MUST be used at exhaust elbow connection, to maintain positive separation of exhaust outlet and muffler inlet.

7. Position oil filter bracket, if so mounted, and attach 1 nut and lockwasher to each stud (bolt, if 6 in. risers); torque in a diagonal pattern to 20-25 lb. ft. (27-34 N·m).

8. Install mufflers and exhaust tubes/hoses, as shown. (Figure 3) Fabricate muffler to thru-transom fitting using 4 in. ID exhaust hose from kit, cut to required length.

9. Double clamp each connection; tighten each clamp securely.

IMPORTANT: After starting engine, check installation for leaks.



24037

a - Muffler
b - Exhaust Tube - Muffler to Elbow
c - Exhaust Hose - Muffler to Thru-Transom Fitting - Cut to Length
d - Double Clamp Each Connection

Figure 4.

NOTE: Removable End of Muffler ALWAYS goes toward exhaust elbow. This places direction marks on muffler body casting at the upper rear corner on the port side.

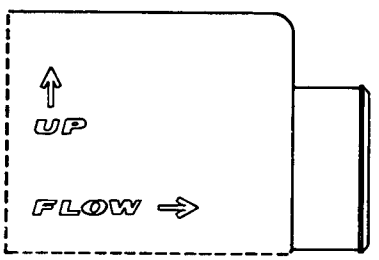


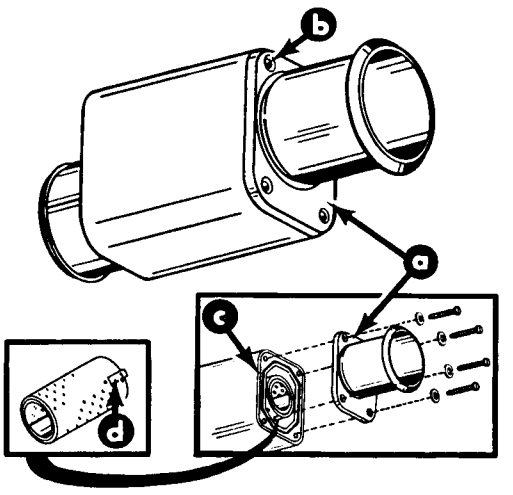
Figure 5.

24037

Maintenance Instructions

Maintenance inspection is owner's responsibility and must be performed at intervals specified in owner's "Operation and Maintenance Manual."

1. Check exhaust elbow attaching-nuts, for adequate tightness [20-25 lb. ft. (27-34 N·m)].
2. Check hose clamps for adequate tightness.
3. Periodically check tubes/hoses for soft spots, brittleness, cracks, and general condition. Replace as necessary.
4. As needed, depending on use conditions, remove mufflers, then remove 4 screws securing forward end plate, and remove end plate and element. Flush element and interior of muffler thoroughly, at least once each year, using pressurized water. (Figure 3)
   a. Check condition of O-ring seal; if dried out or shrunk below mating surface, remove and replace. Clean groove thoroughly.
   b. Glue new O-ring seal in groove, using Sound Blanket Glue (3M Glue EC 887) — Quicksilver P/N 92-25234. Wipe off excess glue immediately.
5. Reinstall muffler end plate with 4 screws. Tighten securely.
6. Reinstall muffler into tubes/hoses. Double clamp. Tighten securely.
7. Check area around exhaust elbow and riser gaskets for leakage. Replace gaskets, if necessary.



24037

a - Removable End Plate
b - 4 Screws Secure End Plate
c - O-ring Seal
d - Element - When Reassembling, Seat Tab in Slot in Casting

Figure 6.

8. If the possibility of freezing exists, remove drain plug from exhaust elbow riser and allow water to drain completely. Reinstall drain plug with Quicksilver Perfect Seal applied to threads.

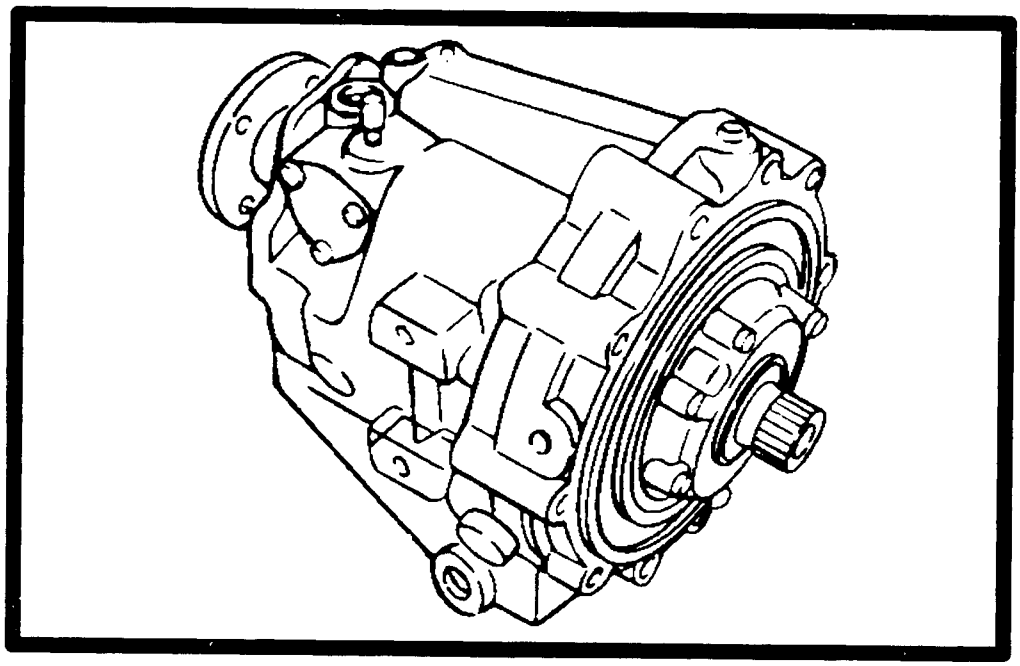
⚠CAUTION

Water must be completely drained from exhaust elbow riser during freezing temperatures, or water may freeze and cause severe damage to riser.

DRIVE SYSTEMS

8

A



VELVET DRIVE®
BORG-WARNER IN-LINE TRANSMISSION

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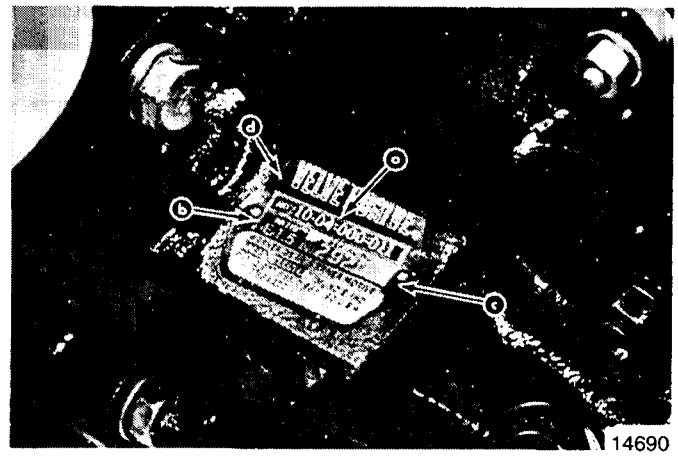
Identification

The transmission identification plate is located on the top left side of the transmission. Refer to charts following to determine engine and transmission combinations.

a - Model Number
b - Ratio (in Forward)
c - Serial Number
d - Identification Plate Model Color Code

Transmission Identification Plate



14690

MIE 5.0 Litre/5.7 Litre/5.7 Competition Ski, 350 Magnum Tournament Ski MODELS WITH IN-LINE TRANSMISSION				
Ratio In Forward Gear (Note 1)	**Identification Plate Color Code**	**Warner Gear Model Number**	**Old Warner Gear Model Number**	**Mercury Marine Part Number**
1:1	Red	10-17-000-004	AS1-71CBR	47805
1.52:1	Red	10-17-000-006	AS2-71CR	47806
1.88:1 (Note 2)	Red	10-17-000-108	AS7-71CR	47807
2.57:1	Red	10-17-000-012	AS14-71CR	47808
2.91:1	Red	10-17-000-014	AS15-71CR	47809

NOTE 1: This ratio is shown on identification plate. Ratio may be rounded off in some cases.
2: The propeller shaft will turn opposite the engine rotation (when in forward gear) on this transmission.

MIE 7.4 Litre, 8.2 Litre MODELS WITH IN-LINE TRANSMISSION				
Ratio In Forward Gear (Note 1)	**Identification Plate Color Code**	**Warner Gear Model Number**	**Old Warner Gear Model Number**	**Mercury Marine Part Number**
1:1	Green	10-18-000-002	AS11-72CR	47810
1.52:1	Green	10-18-000-004	AS12-72CR	47811
1.88:1 (Note 2)	Green	10-18-000-006	AS17-72CR	47812
2.57:1	Green	10-18-000-010	AS14-72CR	47813
2.91:1	Green	10-18-000-012	AS15-72CR	47814

NOTE 1: Ratio is shown on identification plate. Ratio may be rounded off in some cases.
2: Propeller shaft will turn opposite engine rotation (when in forward gear) on this transmission.

Torque Specifications

Fastener Location	Lb. Ft. (N·m)	Lb. In. (N·m)
Drain Plug (Bushing)	25 (34)	
Fluid Hose to Bushing	25 (34)	
Pump Housing to Adaptor		204-264 (23-29)
Rear Mounts to Transmission	45 (61)	
Shift Lever to Valve		96-132 (11-15)
Transmission to Flywheel Housing	50 (68)	
Neutral Start Switch	8-11 (11-14)	

Tools/Lubricants/Sealants

Part Number	Description
91-34569A1	Slide Hammer Puller
92-86154A1	Quicksilver 2-4-C Marine Lubricant
92-34227	Quicksilver Perfect Seal
92-32609-1	Quicksilver Loctite
92-86166	Quicksilver Bellows Adhesive
92-91601-1	Quicksilver RTV Sealer

Specifications

TRANSMISSION FLUID SPECIFICATION
Use only 10 wt. tractor hydraulic fluid meeting the C3/To-2 specification (preferably Mobil 423, Chevron, or Citgo).
NOTE: Citgo has two grades of fluid meeting the C3/To-2 specification; Citgo tractor hydraulic fluid, and Citgo multi-purpose Dexron II – both are acceptable for use.

TRANSMISSION FLUID CAPACITY (APPROXIMATE)	
Engine Model	In-Line Transmission Qts. (litres)
MIE 5.0 Litre, 5.7 Litre, 7.4 Litre, 8.2 Litre	1:1 - 2 (1.9)
	1.5:1 to 2.91:1 - 3 (2.8)

PRESSURE SPECIFICATION - TRANSMISSIONS USING BLACK SPRING (PART NO. 71-242)				
Engine RPM	Neutral Gear PSI (kPa)		Forward or Reverse Gear PSI (kPa)	
	Min.	Max.	Min.	Max.
200			70 (482.6)	
500	115 (792.9)	135 (930.8)	115 (793)	135 (931)
2000			125 (862)	160 (1103)

IN-LINE TRANSMISSION OUTPUT SHAFT ROLLING TORQUE (NOTE 1)		
Model	Ratio	Lb. In. (N·m)
10-17 or 10-18	1:1	50 (68) Max.
10-17 or 10-18	1.2:1/1.52:1	55 (75) Max.
10-17 or 10-18	1.91:1	60 (81) Max.
10-17 or 10-18	2.57:1	65 (88) Max.
10-17 or 10-18	2.91:1	70 (95) Max.

NOTE 1: Transmission is not installed on engine, no fluid in transmission. Use torque wrench and socket on coupling nut.

Important Information

Shift Control and Cables

⚠CAUTION

Shift control and shift cable must position transmission shift lever exactly as stated in this manual, or transmission, as a result of improper shift lever positioning, will not be covered by Warner Gear Warranty.

IMPORTANT: Warner Gear Warranty is jeopardized if the shift lever poppet ball or spring is permanently removed, or if shift lever is repositioned or changed in any manner.

Remote control used must position transmission shift lever over the letter "F" embossed on transmission case when remote control is placed in forward gear position. Transmission failure will occur if transmission shift lever is positioned over the letter "R" and the wrong rotation propeller is used to propel boat forward.

Remote control also must provide a total shift cable travel (at transmission end) of at least 2-3/4 in. (70mm). This is necessary to position transmission shift lever fully in the forward and reverse gear positions. Insufficient shift cable travel will cause transmission to slip and eventually fail.

Engine

Engine rotation is indicated on engine specifications and serial number decal on rocker arm cover. Engine rotation is described when observed from the rear of the engine (transmission end) looking forward (water pump end).

Installed angle of MIE inboard transmission and engine should not exceed a maximum of 18° of the water line.

Transmission

Transmission gear ratio (in forward gear) is marked on transmission identification plate, which is located on the port (left) side of transmission. Transmission output shaft rotation and propeller rotation required is indicated on a decal on transmission case. Transmission rotation is described when viewed from the rear of transmission with transmission in forward gear selector position.

On MIE engines equipped with in-line transmissions having 1:1, 1.5:1, 2.5:1 or 3:1 gear ratios, transmission output shaft rotation is the same as engine rotation with transmission in forward gear. If engine rotation is "LH" (CCW), a "LH" propeller is required. If engine rotation is "RH" (CW), a "RH" propeller is required.

On MIE engines equipped with in-line transmissions having 1.88:1 gear ratio, transmission output shaft rotation is opposite of engine rotation with transmission in forward gear. If engine rotation is "LH" (CCW), a "RH" propeller is required. If engine rotation is "RH" (CW), a "LH" propeller is required.

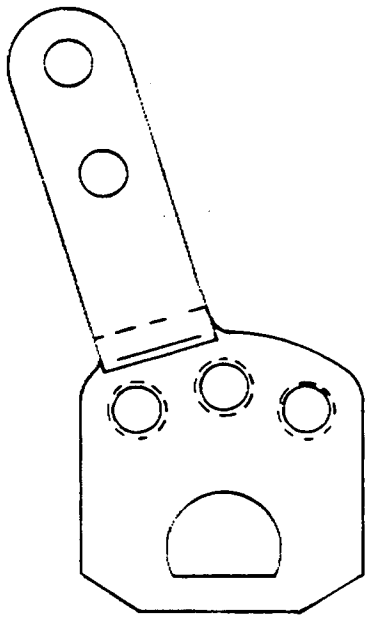
1. DO NOT start or crank engine without fluid in transmission.
2. Use only recommended fluid in transmission.
3. Except in an emergency, never shift transmission at engine speeds above 1000 RPM.
4. Free wheeling of one propeller (in a twin engine boat), at trolling speeds, will not cause damage to the transmission; however, boat operation above trolling speed should be avoided. Be sure proper fluid level exists before free wheeling propeller.
5. DO NOT paint shift lever poppet ball and spring. An accumulation of paint here will prevent proper action of the detent.
6. Always replace oil cooler and hoses after a transmission failure or prior to installing a new or rebuilt transmission. Metallic particles from a failure tend to collect in the cooler and hoses and will gradually flow back into the fluid system and damage transmission.
7. Always use specified oil cooler, hoses and fittings. Hoses must be at least 13/32 in. (10.5mm) I.D. Oil cooler, hoses and fittings must be sufficient size to maintain transmission fluid (in sump) at 140° - 190° F (60° - 88° C).

Propeller

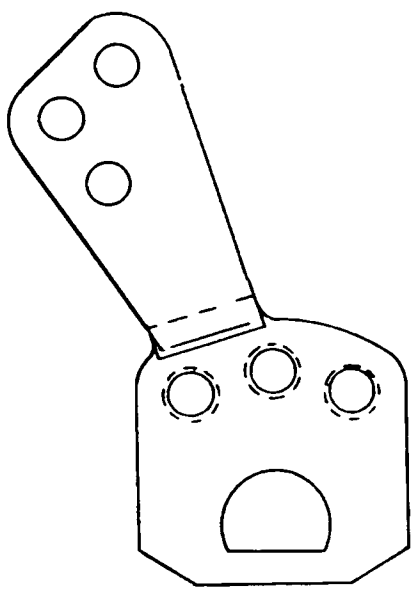
Propeller rotation is described when observed from the rear of the boat (stern) looking forward (bow end). The term "left-hand" ("LH") refers to rotation in the counterclockwise (CCW) direction. The term "right-hand" ("RH") refers to rotation in the clockwise (CW) direction. A "LH" propeller will move the boat forward when rotated counterclockwise. A "RH" propeller will move the boat forward when rotated clockwise. Propeller rotation is not necessarily the same as engine rotation.

Transmission Shift Levers

The lever now has three holes as illustrated following. This prevents the need for adding a part to the previous two-hole lever to provide a third hole (necessary in some installations).



Previous Two-Hole Shift Lever



71304

Present Three-Hole Shift Lever - All Borg-Warner Transmissions

Shift Cable Adjustment

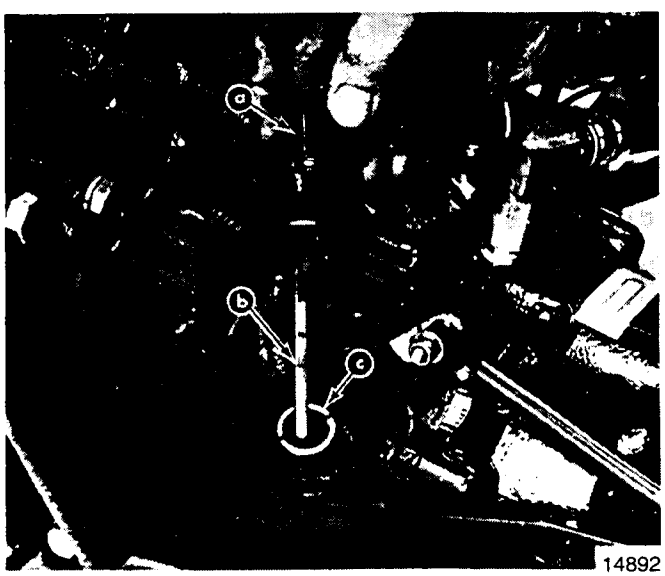
Refer to SECTION 2E - "Removal and Installation - MIE Models with Borg-Warner Transmission."

Checking Transmission Fluid Level

IMPORTANT: Use only specified transmission fluid (see "Specifications").

Check transmission fluid before starting engine each day, as follows:

1. Remove dipstick. Check fluid level as indicated on dipstick. Fluid level may be somewhat over full mark, as some of the fluid from transmission fluid cooler and hoses may have drained back into transmission. If low, add specified transmission fluid to bring level up to full mark on dipstick.



14892

a - Dipstick
b - Full Mark
c - Dipstick Tube

IMPORTANT: To accurately check fluid level, engine must be run at 1500 RPM for 2 minutes immediately prior to checking level.

2. Start engine and run at 1500 RPM for 2 minutes to fill all hydraulic circuits.

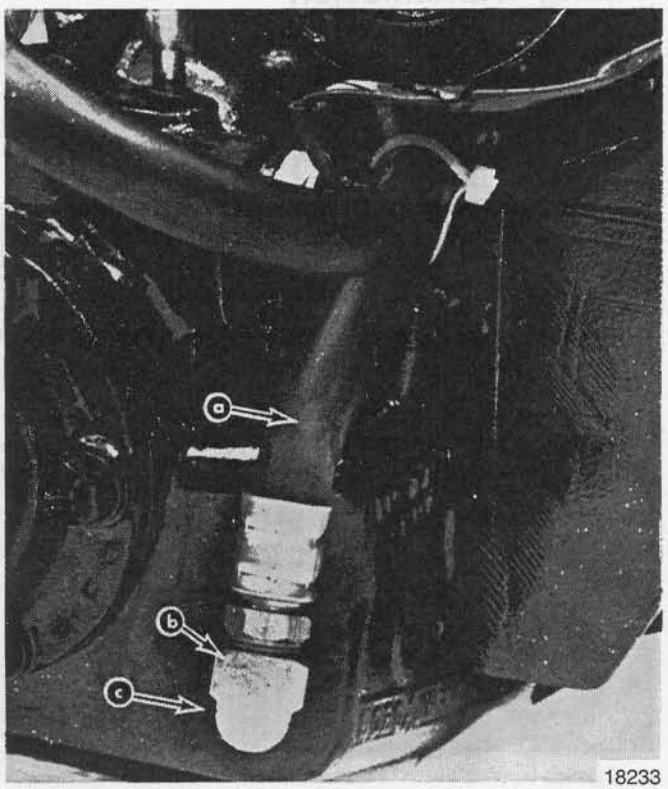
IMPORTANT: Be sure to push dipstick all-the-way down into dipstick tube when checking fluid level.

3. Stop engine and quickly check fluid level. Add transmission fluid, if necessary, to bring level up to full mark on dipstick.
4. Reinstall dipstick.
5. If transmission fluid level was extremely low, carefully check transmission, fluid cooler and hoses for leaks.

Changing Transmission Fluid

Draining Transmission

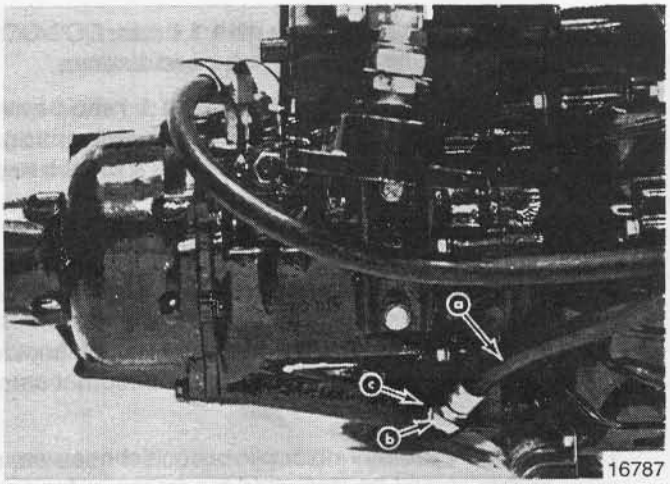
1. Clean area around cooler hose shown and proceed as follows:
   a. Disconnect hose from elbow fitting.
   b. Drain oil from transmission, cooler, and cooler hoses into a suitable container.
   c. Remove elbow fitting from bushing.



18233

a - Hose
b - Elbow Fitting
c - Bushing

MIE 10-17 Transmission 1:1 Ratio

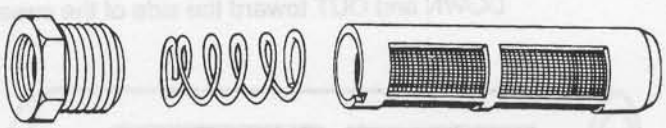


16787

a - Hose
b - Spring
c - Bushing

MIE 10-18 Transmission 1:1 Ratio and All Transmissions with Reduction Ratios

2. Follow instructions "a" or "b":
   a. **On All 10-17 (except 1:1 Ratio) and All 10-18 Transmissions:**
      (1) Remove bushing, spring and strainer tube from transmission case. Allow transmission to drain completely.
      (2) Clean strainer tube in suitable solvent.


71307

a - Bushing
b - Spring
c - Plastic Strainer Tube

All 10-17 (except 1:1 Ratio) and All 10-18 Transmissions

b. **On 10-17 Transmission with 1:1 Ratio:** DO NOT remove bushing or charge tube and strainer.

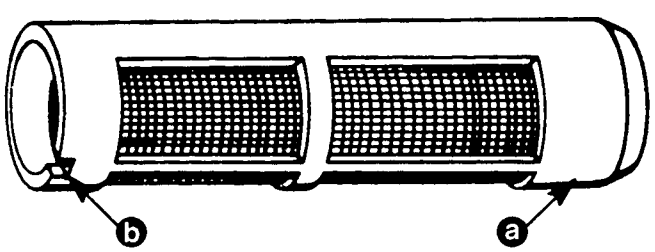
IMPORTANT: 10-17 Transmissions with 1:1 ratio have metal strainers which develop a slight deformation when originally installed. If it is removed it must be replaced to ensure proper function.

3. Check oil for the following foreign matter:
   - **Metal Particles** - A few small particles are normal. Larger metal chips are an early sign of transmission failure which may mean transmission should be disassembled and inspected for internal damage.
   - **Rubber Particles** - Indication of cooler hose wear. Hoses should be inspected for cracks or fraying. Replace damaged hoses.
4. Follow instructions "a" or "b":
   a. **All 10-17 Transmission with 1:1 Ratio:** Proceed to step 5.
   b. **All 10-17 (except 1:1 Ratio) and All 10-18 Transmissions:**

⚠CAUTION

Avoid severe transmission damage, or possible failure of transmission. Strainer must be properly installed as follows.

(1) Install plastic strainer tube with the notch DOWN and OUT toward the side of the case.



71306

a - Plastic Strainer Tube
b - Notch

(2) Install spring.

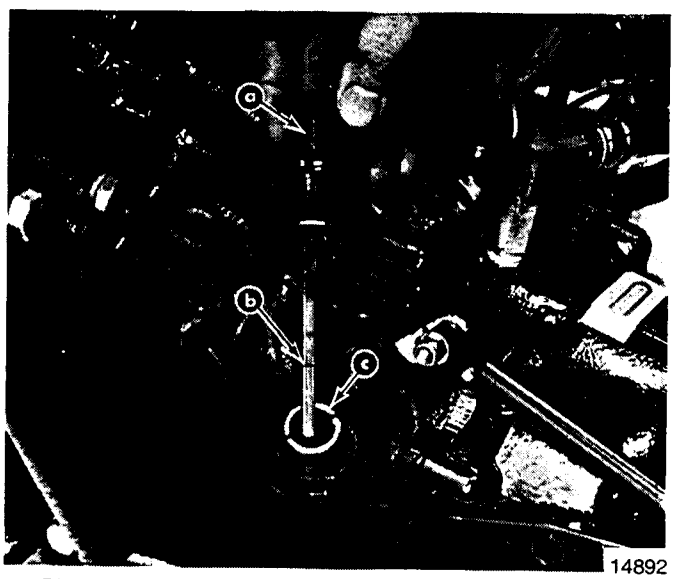
(3) Coat bushing threads with Perfect Seal. Install and torque bushing to 25 lb. ft. (34 N·m).

5. Coat elbow fitting threads with Perfect Seal and install in bushing. Tighten securely.
6. Reconnect hose and tighten securely.
7. Refill transmission with specified fluid. Refer to "Filling Transmission."
8. Check for leaks and check fluid level after first engine start up.

Filling Transmission

IMPORTANT: Use only specified transmission fluid (see "Specifications").

1. Remove dipstick. Fill transmission with fluid, thru dipstick hole, to bring up to full mark.



14892

a - Dipstick
b - Full Mark
c - Dipstick Tube

IMPORTANT: To accurately check fluid level, engine must be run at 1500 RPM for 2 minutes immediately prior to checking level.

2. Start engine and run at 1500 RPM for 2 minutes to fill all hydraulic circuits.

NOTE: Be sure to push dipstick all-the-way down into dipstick tube when checking fluid level.

3. Stop engine and quickly check fluid level. Add transmission fluid, if necessary, to bring level up to full mark on dipstick.
4. Reinstall dipstick. Be sure to tighten "T" handle securely.

Removal and Installation

NOTICE

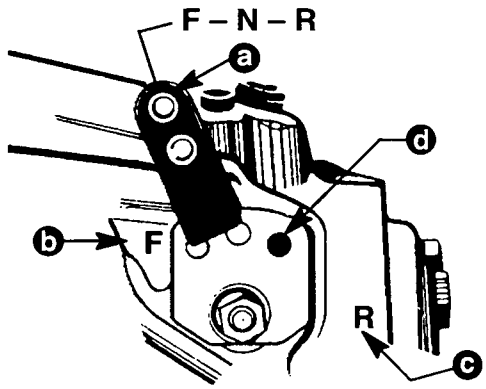
The following procedure describes removal of transmission without removing engine. If engine must be removed, refer to SECTION 2, (see "Table of Contents").

1. Drain transmission fluid,
2. Disconnect fluid cooler hoses.
3. Disconnect shift cable.
4. Disconnect wires from neutral start safety switch.
5. **Models with Audio Warning System:** Disconnect wire from fluid temperature switch.
6. Disconnect propeller shaft coupling.
7. Remove 4 rear mount (to engine bed) bolts.
8. Support rear part of engine with either a hoist or by using wooden blocks under flywheel housing.
9. Remove 2 center transmission to flywheel housing attaching bolts and install 2 long studs.

IMPORTANT: These 2 long studs will help support weight of transmission during removal and installation.

10. Remove remaining transmission attaching bolts.
11. Pull transmission straight back and off engine.
12. Before installing transmission, check transmission pump indexing for correct rotation. Refer to "Pump Indexing."
13. Check transmission output shaft rolling torque. See "Specifications."
14. Apply 2-4-C Marine Lubricant to transmission input shaft splines and engine drive plate splines.
15. If removed, install rear engine mounting brackets (to transmission) as outlined in Section 3, "Engines" (see "Table of Contents"). Torque to 45 lb. ft. (61 N·m).
16. Align transmission splines with drive plate splines.
17. Slide transmission into place and secure with bolts.
18. Remove 2 long studs (installed in step 9) and install remaining 2 bolts. Torque all bolts to 50 lb. ft. (68 N·m).
19. Relieve hoist tension and fasten rear engine mounts to engine bed. Tighten bolts securely.
20. Connect wires to neutral start safety switch.
21. **Models with Audio Warning System:** Connect tan/blue wire to fluid temperature switch.
22. Connect fluid cooler hoses to transmission.
23. Connect and adjust shift cable(s) as outlined in SECTION 2E - "Removal and Installation - MIE Models with Borg-Warner Transmission."

IMPORTANT: Borg-Warner Transmission Warranty is jeopardized if the shift lever poppet ball or spring is permanently removed, if the shift lever is repositioned or changed in any manner or if remote control and shift cable do not position shift lever exactly as shown.



22457

a - Transmission Shift Lever
b - Shift Lever Must Be Over This Letter When Propelling Boat FORWARD
c - Shift Lever Must Be Over This Letter When Propelling Boat in REVERSE
d - Poppet Ball Must Be Centered in Detent Hole for Each F-N-R Position (Forward Gear Shown)

24. Refer to SECTION 2E - "Removal and Installation - MIE Models with Borg-Warner Transmission" and check engine final alignment as outlined.
25. After engine has been properly aligned, connect propeller shaft coupler to transmission output flange. Attach couplers together with bolts, lockwashers and nuts. Torque to 50 lb. ft. (68 N·m).
26. Refill transmission with specified fluid. Refer to "Filling Transmission."
27. Check for leaks and check fluid level after first engine start up.

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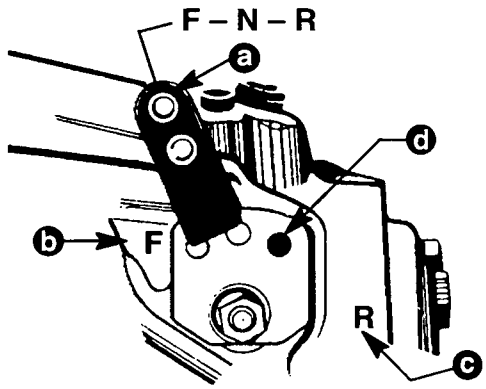
IMPORTANT: Borg-Warner Transmission Warranty is jeopardized if the shift lever poppet ball or spring is permanently removed, if the shift lever is repositioned or changed in any manner or if remote control and shift cable do not position shift lever exactly as shown.



22457

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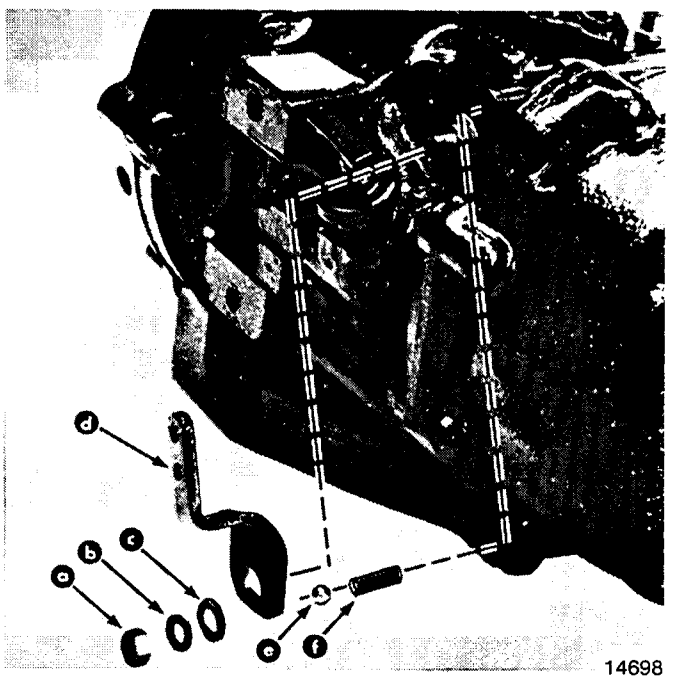
25. After engine has been properly aligned, connect propeller shaft coupler to transmission output flange. Attach couplers together with bolts, lockwashers and nuts. Torque to 50 lb. ft. (68 N·m).
26. Refill transmission with specified fluid. Refer to "Filling Transmission."
27. Check for leaks and check fluid level after first engine start up.

Shift Lever Installation

IMPORTANT: Warner Gear warranty is jeopardized if the shift lever poppet spring and/or ball is permanently removed, or if the shift lever is changed in any manner, or repositioned, or if the linkage between the remote control and the transmission shift lever does not have sufficient travel in both directions.

Shift lever and related parts must be assembled as shown.

1. Lubricate poppet ball, spring, and holes in shift lever with 2-4-C Marine Lubricant.
2. Torque nut to 96-132 lb. in. (11-15 N·m).



14698

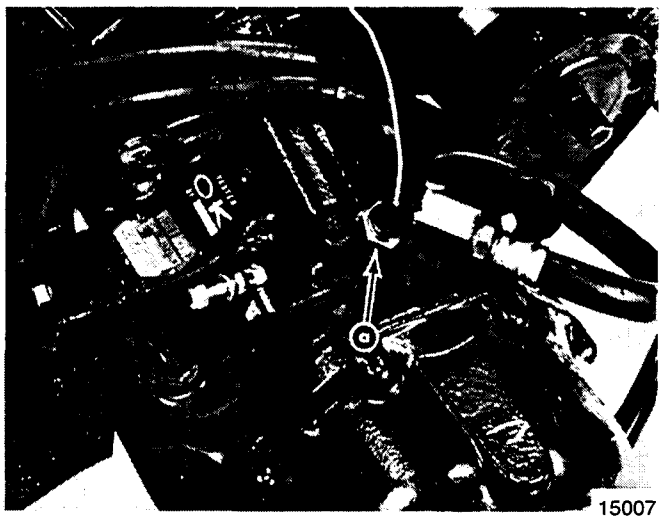
a - Nut
b - Lockwasher
c - Flat Washer
d - Shift Lever
e - Poppet Ball
f - Poppet Spring

Typical Shift Lever

3. After installation, move shift lever thru forward, neutral and reverse positions. No more than finger tip effort should be required. If valve binds, cause for binding must be found and corrected.

Pressure Test

1. Install pressure gauge.



15007

a - Main Line Pressure Tap – Models with Audio Warning System, Remove Temperature Switch; Models without Switch, Remove 3/8 in. Pipe Plug

2. With boat in water, start engine and run until normal operating temperature is reached.
3. Refer to "Specifications" (see "Table of Contents") for pressure readings.

Transmission Repair

In-Line

Mercury Marine does not stock or sell replacement parts for the in-line transmission. Warner Gear has a network of distributors throughout the world to service their product. These distributors, in turn, have a dealer network to service the transmissions. Also, service manuals (for each transmission) can be obtained from Warner Gear.

IMPORTANT: Refer to "Special Replacement Part Information" before working on transmission.

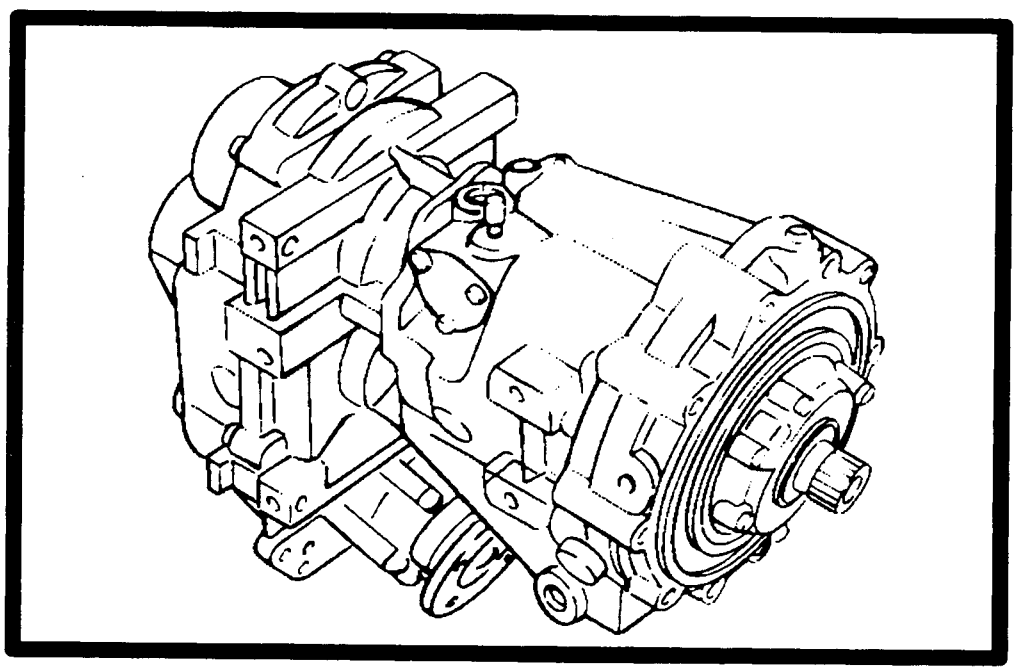
For the location of your closest distributor or service literature contact:

Borg-Warner
Marine and Industrial Transmissions
Theodore Rice Boulevard
Industrial Park
New Bedford, MA 02745
Phone: (508) 995-2616

DRIVE SYSTEMS

8

B



VELVET DRIVE®
BORG-WARNER V-DRIVE TRANSMISSION

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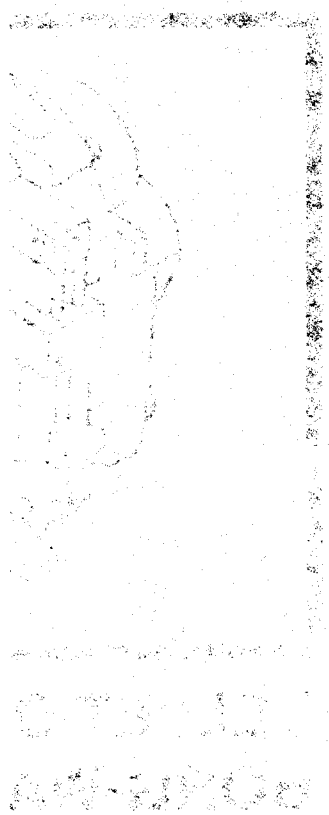
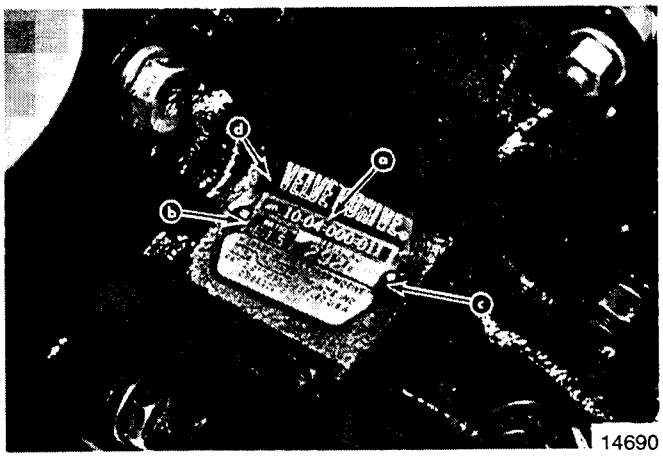


Identification

The transmission identification plate is located on the top left side of the transmission. Refer to charts following to determine engine and transmission combinations.

a - Model Number
b - Ratio (in Forward)
c - Serial Number
d - Identification Plate Model Color Code

Transmission Identification Plate



14690

MIE 5.0 Litre/5.7 Litre MODELS WITH V-DRIVE TRANSMISSION				
Ratio In Forward Gear (Note 1)	**Identification Plate Color Code**	**Warner Gear Model Number**	**Assembly Numbers (Note 2)**	**Mercury Marine Part Number**
1:1	Red	10-04-000-009	10-04-410-001 (13-08-410-009)	60953
1.51:1	Red	10-04-000-011	10-04-410-001 (13-08-410-011)	60588
1.99:1	Red	10-04-000-002	10-04-410-001 (13-08-410-002)	60954
2.49:1	Red	10-04-000-005	10-04-410-001 (13-08-410-005)	60955
3.14:1	Red	10-04-000-007	10-04-410-001 (13-08-410-007)	60956

NOTE 1: Ratio is shown on identification plate. Ratio may be rounded off in some cases.
2: 10-410-001 is the part number for the front box (forward and reverse gear). 13-08-410-____ is part number for the V-Drive box.

MIE 7.4/8.2 Litre MODELS WITH V-DRIVE TRANSMISSION				
Ratio In Forward Gear (Note 1)	**Identification Plate Color Code**	**Warner Gear Number**	**Assembly Numbers (Note 2)**	**Mercury Marine Part Number**
1.21:1	Green	10-05-000-012	10-05-410-001 (13-08-410-012)	12119
1.51:1	Green	10-05-000-011	10-05-410-001 (13-08-410-011)	60959
1.99:1	Green	10-05-000-002	10-05-410-001 (13-08-410-002)	60960
2.49:1	Green	10-05-000-005	10-05-410-001 (13-08-410-005)	60961
3.14:1	Green	10-05-000-007	10-05-410-001 (13-08-410-007)	60962

NOTE 1: Ratio is shown on identification plate. Ratio may be rounded off in some cases.
2: 10-410-001 is the part number for the front box (forward and reverse gear). 13-08-410-____ is part number for the V-Drive box.

Torque Specifications

Fastener Location	Lb. Ft. (N·m)	Lb. In. (N·m)
Drain Plug (Bushing)	25 (34)	
Fluid Hose to Bushing	25 (34)	
Pump Housing to Adaptor		204-264 (23-29)
Rear Mounts to Transmission	45 (61)	
Shift Lever to Valve		96-132 (11-15)
Transmission to Flywheel Housing	50 (68)	
Neutral Start Switch	8-11 (11-14)	

Tools/Lubricants/Sealants

Part Number	Description
91-34569A1	Slide Hammer Puller
92-86154A1	Quicksilver 2-4-C Marine Lubricant
92-34227	Quicksilver Perfect Seal
92-32609-1	Quicksilver Loctite
92-86166	Quicksilver Bellows Adhesive
92-91601-1	Quicksilver RTV Sealer

Specifications

TRANSMISSION FLUID SPECIFICATION
Use only 10 wt. tractor hydraulic fluid meeting the C3/To-2 specification (preferably Mobil 423, Chevron, or Citgo).
NOTE: Citgo has two grades of fluid meeting the C3/To-2 specification; Citgo tractor hydraulic fluid, and Citgo multi-purpose Dexron II – both are acceptable for use.

TRANSMISSION FLUID CAPACITY (APPROXIMATE)	
Engine Model	V-Drive Transmission U.S. Qts. (litres)
MIE 5.0/5.7/ 7.4/8.2 Litre	4-1/2 (4.3)

PRESSURE SPECIFICATION - TRANSMISSIONS USING BLACK SPRING (PART NO. 71-242)				
Engine RPM	Neutral Gear PSI (kPa)		Forward or Reverse Gear PSI (kPa)	
	Min.	Max.	Min.	Max.
200			70 (483)	
500	115 (792.9)	135 (930.8)	115 (793)	135 (931)
2000			125 (862)	160 (1103)

V-DRIVE TRANSMISSION OUTPUT SHAFT ROLLING TORQUE (NOTE 1)		
Model	Ratio	Lb. In. (N·m)
10-04 or 10-05	1.21:1	55 (75) Max.
10-04 or 10-05	1.52:1	
10-04 or 10-05	1.91:1	60 (81) Max.
10-04 or 10-05	2.57:1	65 (88) Max.
10-04 or 10-05	2.91:1	70 (95) Max.

NOTE 1: Transmission is not installed on engine, no fluid in transmission. Use torque wrench and socket on coupling nut.

Important Information

Shift Control and Cables

⚠CAUTION

Shift control and shift cable must position transmission shift lever exactly as stated in this manual, or transmission, as a result of improper shift lever positioning, will not be covered by Warner Gear Warranty.

IMPORTANT: Warner Gear Warranty is jeopardized if the shift lever poppet ball or spring is permanently removed, or if shift lever is repositioned or changed in any manner.

Remote control used must position transmission shift lever over the letter "F" embossed on transmission case when remote control is placed in forward gear position. Transmission failure will occur if transmission shift lever is positioned over the letter "R" and the wrong rotation propeller is used to propel boat forward.

Remote control also must provide a total shift cable travel (at transmission end) of at least 2-3/4 in. (70mm). This is necessary to position transmission shift lever fully in the forward and reverse gear positions. Insufficient shift cable travel will cause transmission to slip and eventually fail.

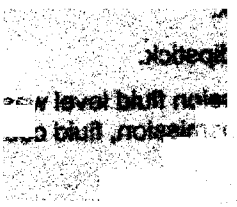
Engine

Engine rotation is indicated on engine specifications and serial number decal on rocker arm cover. Engine rotation is described when observed from the rear of the engine (transmission end) looking forward (water pump end).

Installed angle of MIE inboard transmission and engine should not exceed a maximum of 18° of the water line.

Transmission

Transmission gear ratio (in forward gear) is marked on transmission identification plate, which is located on the port (left) side of transmission. Transmission output shaft rotation and propeller rotation required is indicated on a decal on transmission case. Transmission rotation is described when viewed from the rear of transmission with transmission in forward gear selector position.



On MIE engines which are equipped with V-drive transmissions, transmission output shaft rotation is the same as engine rotation with transmission in forward gear. Because of reversed engine mounting position, however, a "RH" propeller is required, if engine is "LH" (CCW) rotation; or "LH" rotation propeller is required, if engine is "RH" (CW) rotation.

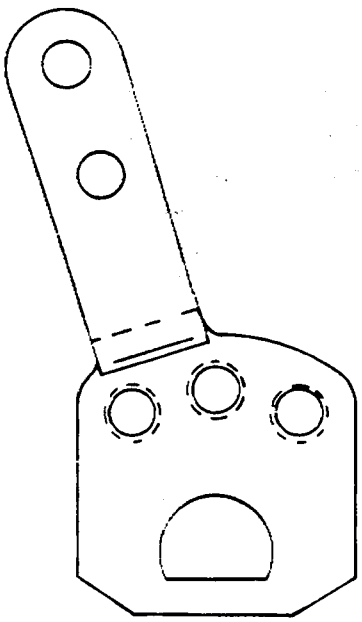
4. DO NOT start or crank engine without fluid in transmission.
5. Use only recommended fluid in transmission.
6. Except in an emergency, never shift transmission at engine speeds above 1000 RPM.
7. Free wheeling of one propeller (in a twin engine boat), at trolling speeds, will not cause damage to the transmission; however, boat operation above trolling speed should be avoided. Be sure proper fluid level exists before free wheeling propeller.
8. DO NOT paint shift lever poppet ball and spring. An accumulation of paint here will prevent proper action of the detent.
9. Always replace oil cooler and hoses after a transmission failure or prior to installing a new or rebuilt transmission. Metallic particles from a failure tend to collect in the cooler and hoses and will gradually flow back into the fluid system and damage transmission.
10. Always use specified oil cooler, hoses and fittings. Hoses must be at least 13/32 in. (10.5mm) I.D. Oil cooler, hoses and fittings must be sufficient size to maintain transmission fluid (in sump) at 140° - 190° F (60° - 88° C).

Propeller

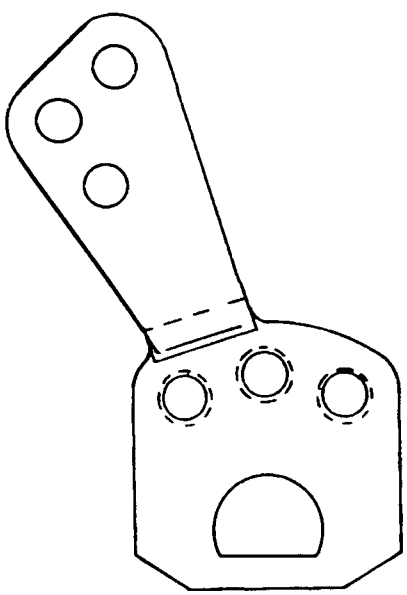
Propeller rotation is described when observed from the rear of the boat (stern) looking forward (bow end). The term "left-hand" ("LH") refers to rotation in the counterclockwise (CCW) direction. The term "right-hand" ("RH") refers to rotation in the clockwise (CW) direction. A "LH" propeller will move the boat forward when rotated counterclockwise. A "RH" propeller will move the boat forward when rotated clockwise. Propeller rotation is not necessarily the same as engine rotation.

Transmission Shift Levers

The lever now has three holes as illustrated following. This prevents the need for adding a part to the previous two-hole lever to provide a third hole (necessary in some installations).



Previous Two-Hole Shift Lever



71304

Present Three-Hole Shift Lever - All Borg-Warner Transmissions

Shift Cable Adjustment

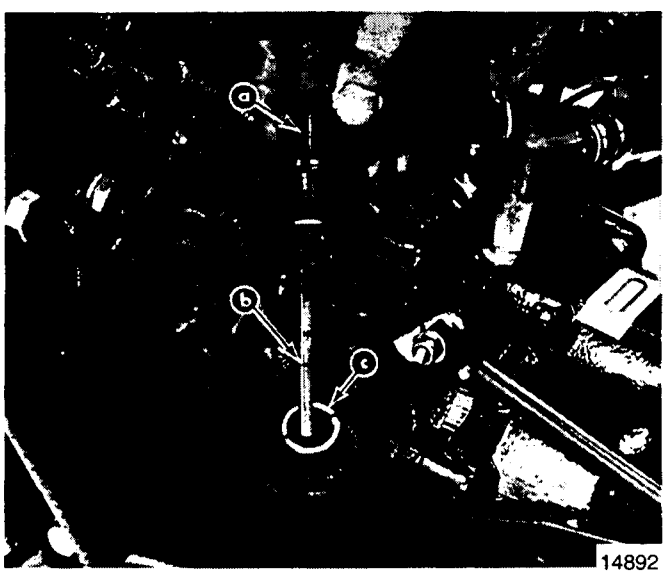
Refer to SECTION 2E - "Removal and Installation - MIE Models with Borg-Warner Transmission."

Checking Transmission Fluid Level

IMPORTANT: Use only specified transmission fluid (see "Specifications").

Check transmission fluid before starting engine each day, as follows:

1. Remove dipstick. Check fluid level as indicated on dipstick. Fluid level may be somewhat over full mark, as some of the fluid from transmission fluid cooler and hoses may have drained back into transmission. If low, add specified transmission fluid to bring level up to full mark on dipstick.



14892

a - Dipstick
b - Full Mark
c - Dipstick Tube

IMPORTANT: To accurately check fluid level, engine must be run at 1500 RPM for 2 minutes immediately prior to checking level.

2. Start engine and run at 1500 RPM for 2 minutes to fill all hydraulic circuits.

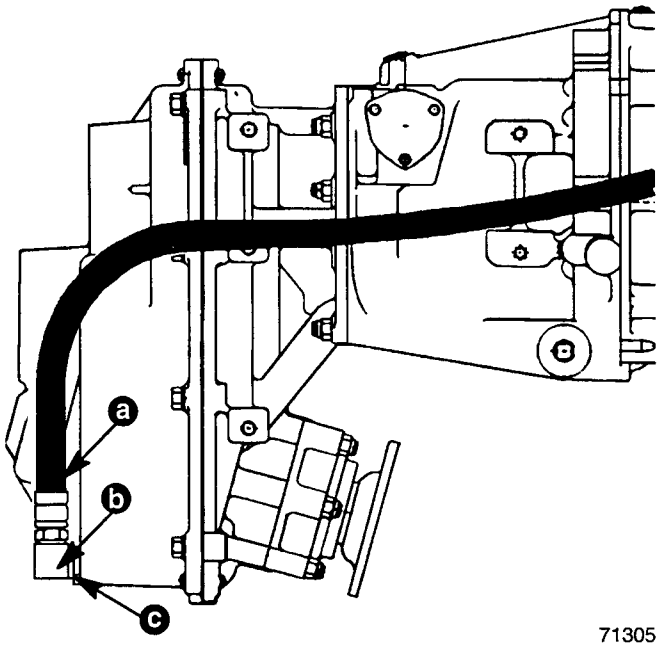
IMPORTANT: Be sure to push dipstick all-the-way down into dipstick tube when checking fluid level.

3. Stop engine and quickly check fluid level. Add transmission fluid, if necessary, to bring level up to full mark on dipstick.
4. Reinstall dipstick.
5. If transmission fluid level was extremely low, carefully check transmission, fluid cooler and hoses for leaks.

Changing Transmission Fluid

Draining Transmission

1. Clean area around cooler hose shown and proceed as follows:
   a. Disconnect hose from elbow fitting.
   b. Remove elbow fitting from bushing.
   c. Drain oil from transmission, cooler, and cooler lines into a suitable container.



71305

a - Hose
b - Elbow Fitting
c - Bushing

Typical MIE 10-04 and 10-05 Transmission

2. Check oil for the following foreign matter:
   - **Metal Particles** - A few small particles are normal. Larger metal chips are an early sign of transmission failure which may mean transmission should be disassembled and inspected for internal damage.
   - **Rubber Particles** - Indication of cooler hose wear. Hoses should be inspected for cracks or fraying. Replace damaged hoses.

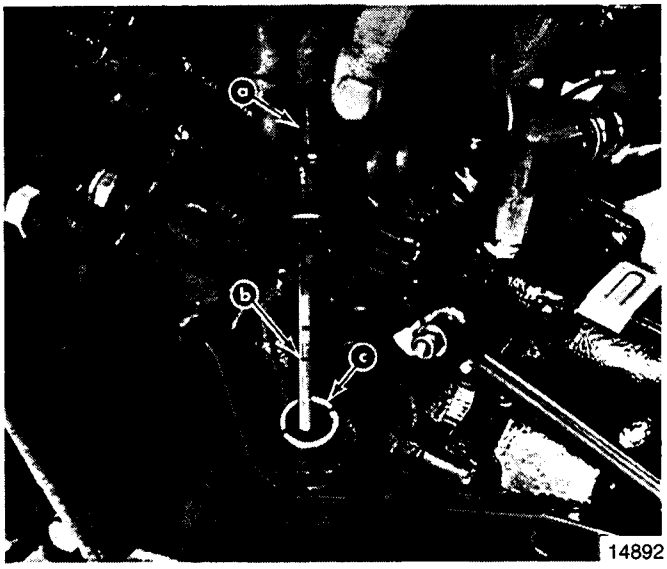
NOTE: Coat threads of bushing with Perfect Seal and install in transmission case if it came loose with elbow fitting. Torque bushing to 25 lb. ft. (34 N·m).

3. Coat elbow fitting threads with Perfect Seal and install in bushing. Tighten securely.
4. Reconnect hose and tighten securely.
5. Refill transmission with specified fluid. Refer to "Filling Transmission."

Filling Transmission

IMPORTANT: Use only specified automatic transmission fluid (see "Specifications").

1. Remove dipstick. Fill transmission with fluid, thru dipstick hole, to bring up to full mark.



14892

a - Dipstick
b - Full Mark
c - Dipstick Tube

IMPORTANT: To accurately check fluid level, engine must be run at 1500 RPM for 2 minutes immediately prior to checking level.

2. Start engine and run at 1500 RPM for 2 minutes to fill all hydraulic circuits.

NOTE: Be sure to push dipstick all-the-way down into dipstick tube when checking fluid level.

3. Stop engine and quickly check fluid level. Add automatic transmission fluid, if necessary, to bring level up to full mark on dipstick.
4. Reinstall dipstick. Be sure to tighten "T" handle securely.

Removal and Installation

NOTICE

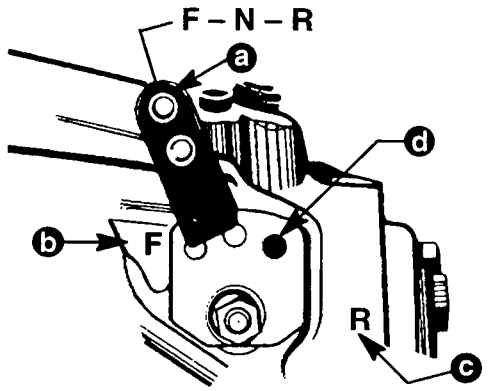
The following procedure describes removal of transmission without removing engine. If engine must be removed, refer to SECTION 2, (see "Table of Contents").

1. Drain transmission fluid,
2. Disconnect fluid cooler hoses.
3. Disconnect shift cable.
4. Disconnect wires from neutral start safety switch.
5. **Models with Audio Warning System:** Disconnect wire from fluid temperature switch.
6. Disconnect propeller shaft coupling.
7. Remove 4 rear mount (to engine bed) bolts.
8. Support rear part of engine with either a hoist or by using wooden blocks under flywheel housing.
9. Remove 2 center transmission to flywheel housing attaching bolts and install 2 long studs.

IMPORTANT: These 2 long studs will help support weight of transmission during removal and installation.

10. Remove remaining transmission attaching bolts.
11. Pull transmission straight back and off engine.
12. Before installing transmission, check transmission pump indexing for correct rotation. Refer to "Pump Indexing."
13. Check transmission output shaft rolling torque. See "Specifications."
14. Apply 2-4-C Marine Lubricant to transmission input shaft splines and engine drive plate splines.
15. If removed, install rear engine mounting brackets (to transmission) as outlined in Section 3, "Engines" (see "Table of Contents"). Torque to 45 lb. ft. (61 N·m).
16. Align transmission splines with drive plate splines.
17. Slide transmission into place and secure with bolts.
18. Remove 2 long studs (installed in step 9) and install remaining 2 bolts. Torque all bolts to 50 lb. ft. (68 N·m).
19. Relieve hoist tension and fasten rear engine mounts to engine bed. Tighten bolts securely.
20. Connect wires to neutral start safety switch.
21. **Models with Audio Warning System:** Connect tan/blue wire to fluid temperature switch.
22. Connect fluid cooler hoses to transmission.
23. Connect and adjust shift cable(s) as outlined in SECTION 2E - "Removal and Installation - MIE Models with Borg-Warner Transmission."

IMPORTANT: Borg-Warner Transmission Warranty is jeopardized if the shift lever poppet ball or spring is permanently removed, if the shift lever is repositioned or changed in any manner or if remote control and shift cable do not position shift lever exactly as shown.



22457

a - Transmission Shift Lever
b - Shift Lever Must Be Over This Letter When Propelling Boat FORWARD
c - Shift Lever Must Be Over This Letter When Propelling Boat in REVERSE
d - Poppet Ball Must Be Centered in Detent Hole for Each F-N-R Position (Forward Gear Shown)

24. Refer to SECTION 2E - "Removal and Installation - MIE Models with Borg-Warner Transmission" and check engine final alignment as outlined.
25. After engine has been properly aligned, connect propeller shaft coupler to transmission output flange. Attach couplers together with bolts, lockwashers and nuts. Torque to 50 lb. ft. (68 N·m).
26. Refill transmission with specified fluid. Refer to "Filling Transmission."
27. Check for leaks and check fluid level after first engine start up.

Pump Indexing

Pump must be correctly indexed to correspond with engine rotation. If pump is not indexed correctly, pump will not create oil pressure and transmission will not shift. Pump housing has two arrows, each pointing in a different direction. Pump must be positioned so that the arrow (pointing in the direction that input shaft and pump will be turned by engine) is at the top of transmission.

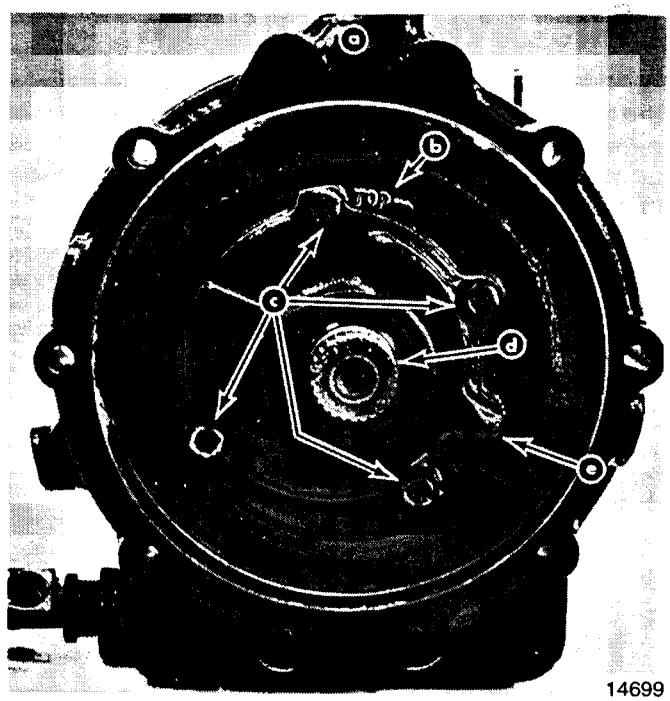
IMPORTANT: Some transmissions have letters "R.H." and "L.H." on pump housing. Letters DO NOT indicate engine rotation.

If pump must be reindexed, proceed as follows:

1. Remove 4 pump attaching bolts.
2. Loosen the pump housing. A soft tip mallet may be used to tap the fluid passage boss. Do not strike the bolt bosses.

IMPORTANT: Do not remove the pump from the shaft unless a seal protector is used to prevent the shaft splines from cutting the pump seal. Care must be taken to ensure that seal, gasket, seal and bolt bosses are kept in good condition to prevent leaks in those critical areas.

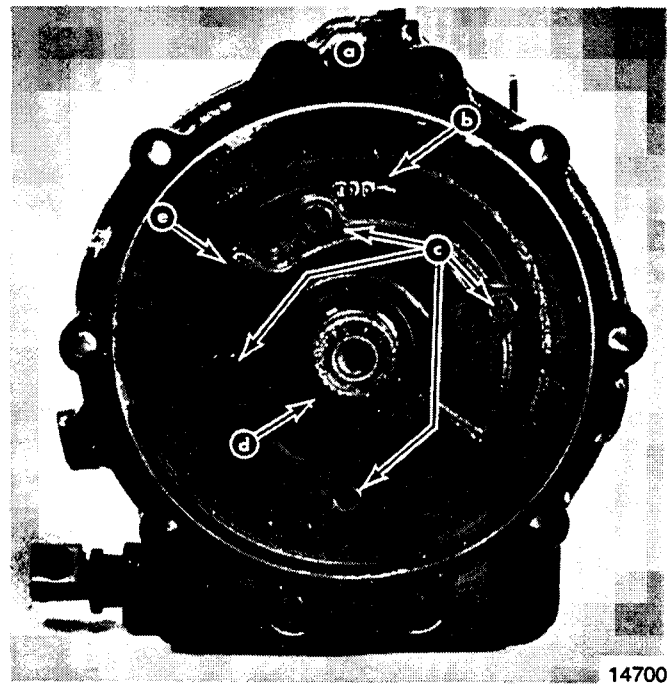
3. Make sure that pump gasket is not sticking to housing (to prevent gasket from tearing or folding) when rotating pump.
4. Rotate pump until arrow indicating the proper direction of pump rotation is near the top of transmission.
5. Reinstall 4 pump to adaptor attaching bolts and torque to 204-264 lb. in. (23-29 N·m).



14699

a - Top of Transmission
b - Top → (or Top R.H.)
c - Pump Attaching Bolts
d - Input Shaft
e - Fluid Passage Boss

MIE L.H. (Standard) Rotation Engines



14700

a - Top of Transmission
b - Top ← (or Top L.H.)
c - Pump Attaching Bolts
d - Input Shaft
e - Fluid Passage Boss

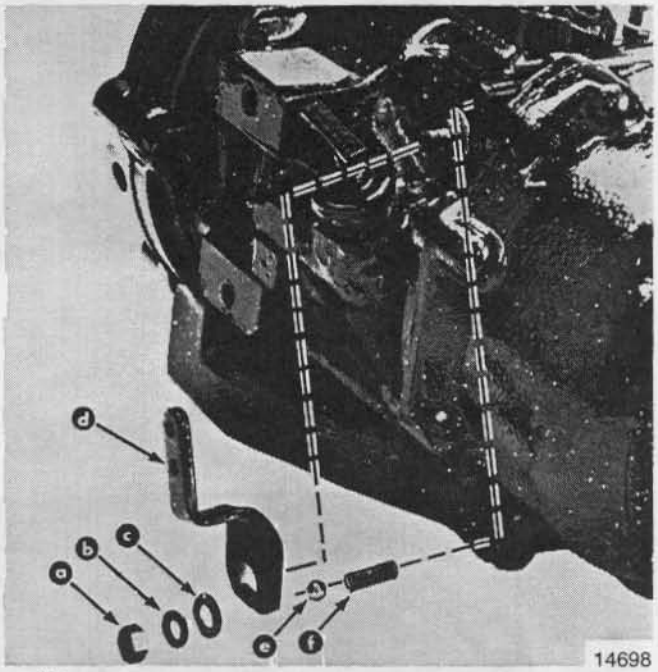
MIE R.H. (Opposite) Rotation Engines

Shift Lever Installation

IMPORTANT: Warner Gear warranty is jeopardized if the shift lever poppet spring and/or ball is permanently removed, or if the shift lever is changed in any manner, or repositioned, or if the linkage between the remote control and the transmission shift lever does not have sufficient travel in both directions.

Shift lever and related parts must be assembled as shown.

1. Lubricate poppet ball, spring, and holes in shift lever with 2-4-C Marine Lubricant.
2. Torque nut to 96-132 lb. in. (11-15 N·m).



14698

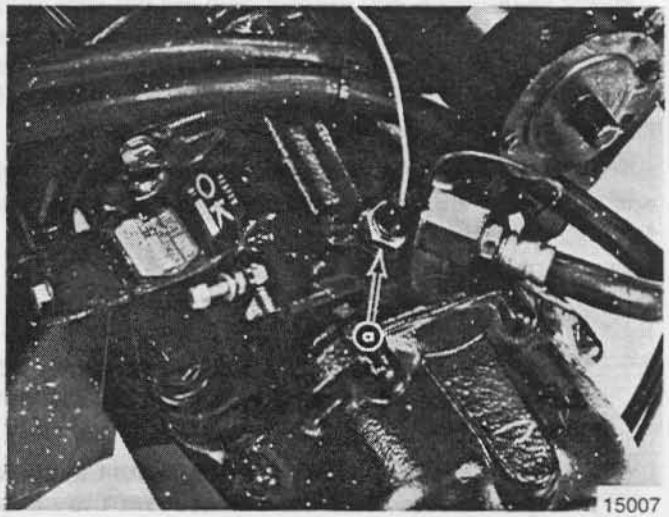
a - Nut
b - Lockwasher
c - Flat Washer
d - Shift Lever
e - Poppet Ball
f - Poppet Spring

Typical Shift Lever

3. After installation, move shift lever thru forward, neutral and reverse positions. No more than finger tip effort should be required. If valve binds, cause for binding must be found and corrected.

Pressure Test

1. Install pressure gauge.


15007

a - Main Line Pressure Tap – Models with Audio Warning System, Remove Temperature Switch; Models without Switch, Remove 3/8 in. Pipe Plug

2. With boat in water, start engine and run until normal operating temperature is reached.
3. Refer to "Specifications" (see "Table of Contents") for pressure readings.

Transmission Repair

V-Drive

Mercury Marine does not stock or sell replacement parts for the V-drive transmission. Warner Gear has a network of distributors throughout the world to service their product. These distributors, in turn, have a dealer network to service the transmissions. Also, service manuals (for each transmission) can be obtained from Warner Gear.

IMPORTANT: Refer to "Special Replacement Part Information" before working on transmission.

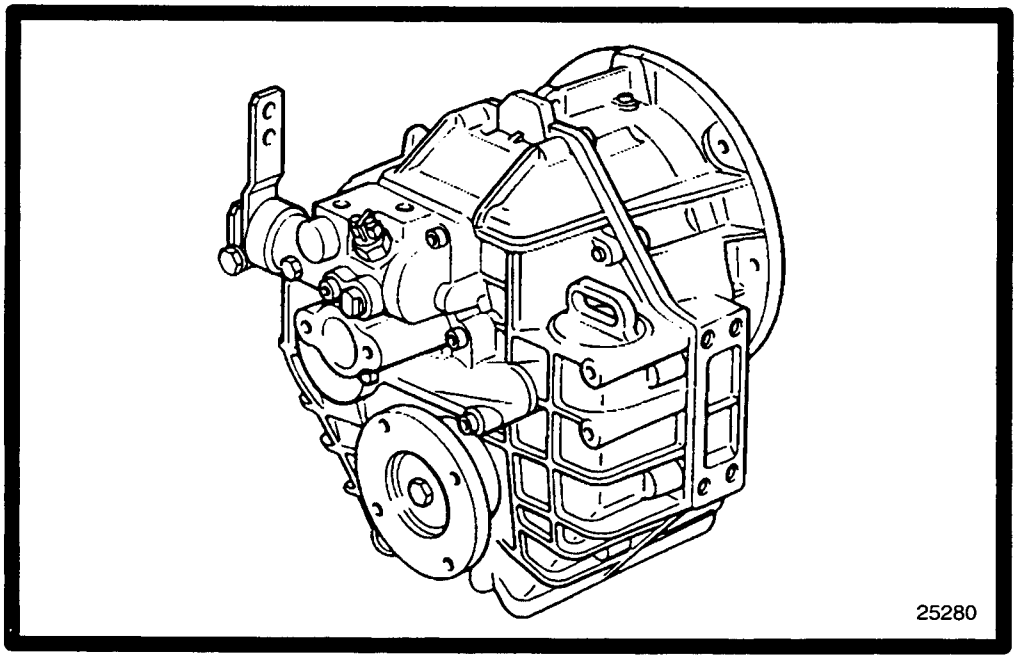
For the location of your closest distributor or service literature contact:

Borg-Warner
Marine and Industrial Transmissions
Theodore Rice Boulevard
Industrial Park
New Bedford, MA 02745
Phone: (508) 995-2616

DRIVE SYSTEMS

8

C



HURTH DOWN ANGLE TRANSMISSION

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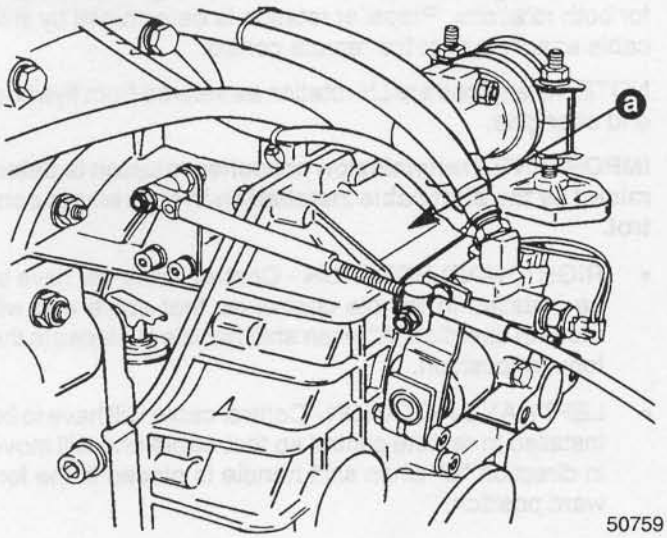
Identification

The transmission identification plate is located on the top rear of the transmission.



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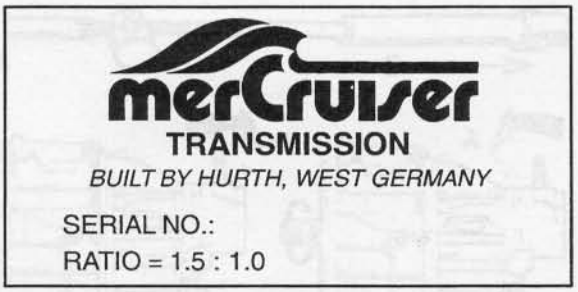


Early Style Identification Plate

Typical Late Style Identification Plate

a - Transmission Identification Plate
(Stating: Gear Ratio, Serial Number and Model)

Torque Specifications

FASTENER LOCATION	Lb. Ft. (N·m)
Transmission Housing Halves Bolts and Nuts	36 lb. ft. (49 N·m)
Control Block to Housing Bolts	18 lb. ft. (25 N·m)
Output Flange to Output Shaft	63 lb. ft. (85 N·m)
Mounts	50 lb. ft. (68 N·m)
Transmission to Flywheel Housing	50 lb. ft. (68 N·m)

Specifications

OPERATING SPECIFICATIONS	
Shifting Pressure	312-377 psi (2151-2599 kPa)
Operating Temperature	130° - 250° F (54° - 121° C)

Lubricants/Sealants

ATF - Dexron II - D	Obtain Locally
Loctite Type "A" (Screws/Bolts/Flange)	Obtain Locally
Loctite 515 (Split-Line)	Obtain Locally

Capacity

Model	U.S. Qts. (litres)
Hurth - 630A 8° Down Angle	4.25 (4.0)[1]
Hurth - 800AM 8° Down Angle	4.40 (4.2)[1]

[1] Always use dipstick to determine exact quantity of oil required.

Special Tools

MERCURY MARINE SPECIAL TOOLS

Description	Part No.
Tapered Roller Bearing Inner Race Puller	91-813950
Tapered Roller Bearing Outer Race Puller	91-813951
Pressure Plate Removal Tool - Reversing Clutch	91-813952
Tapered Roller Bearing Inner Race Puller Plate	91-813953
Mandrel - Input Shaft Seal	91-813955
Mandrel - Output Shaft Seal	91-813956
Preload Tool - Input Shaft	91-813957
Preload Tool - Intermediate Shaft	91-813958

OTHER SPECIAL TOOLS	
Pressure Gauge (M10x1 Thread)	Obtain Locally
Thermometer [(3/8 in. Thread, 0° - 270° F (-18° - 132° C)]	Obtain Locally

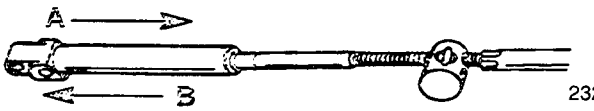
General

The Hurth transmission is a "full power reversing" transmission, allowing a standard (LH rotation) engine to be used for both rotations. Propeller rotation is determined by shift cable attachment at the remote control.

NOTE: All engines are LH rotation as viewed from flywheel end of engine.

IMPORTANT: Transmission propeller rotation is determined by the shift cable installation in the remote control.

- RIGHT HAND ROTATION - Control cable will have to be installed in remote control so that cable end will move in direction "A" when shift handle is placed in the forward position.
- LEFT HAND ROTATION - Control cable will have to be installed in remote control so that cable end will move in direction "B" when shift handle is placed in the forward position.



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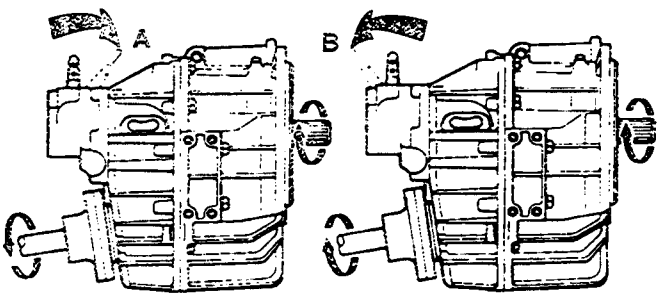

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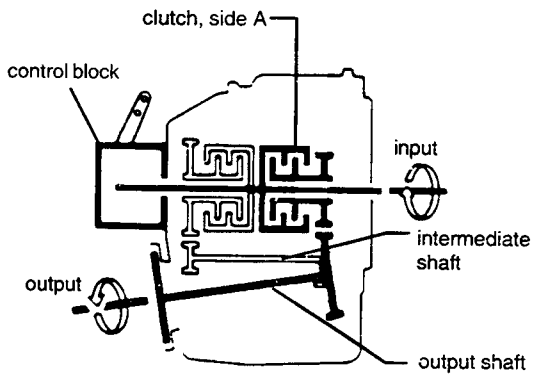
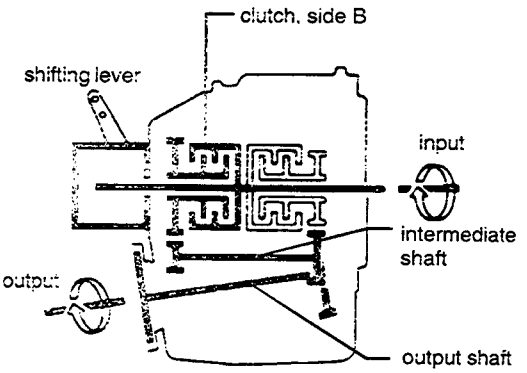


"A" is Forward Gear for RH Rotation Propeller



"B" is Forward Gear for LH Rotation Propeller

Shifting lever in position	Propeller rotation	Propeller
A	Opposite to engine rotation	Right hand (RH)
B	Same as engine rotation	Left hand (LH)

TRANSMISSION RATIOS

Transmission Model	630A			800AM	
Nominal transmission ratio	1.5	2.0	2.5	2.5	2.8
Transm. ratio shifting pos. "A" (forward gear)	1.56	2.04	2.52	2.50	2.85
Transm. ratio shifting pos. "B" (reverse gear)	1.58	2.10	2.53	2.46	2.80

Shift Cable Installation and Adjustment

IMPORTANT: When installing shift cables, be sure that cables are routed in such a way as to avoid sharp bends and/or contact with moving parts. DO NOT fasten any items to shift cables.

⚠CAUTION

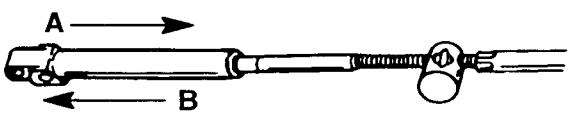
Avoid severe transmission damage. All Hurth transmissions require standard left-hand rotation engines. Never connect a Hurth transmission to a right-hand rotation engine.

IMPORTANT: These Hurth transmissions are full reversing transmissions. Direction of output/propeller rotation is determined by hookup of shift cable at remote control.

NOTE: Shift cable must be hooked up to remote control before starting installation and adjustment procedures.

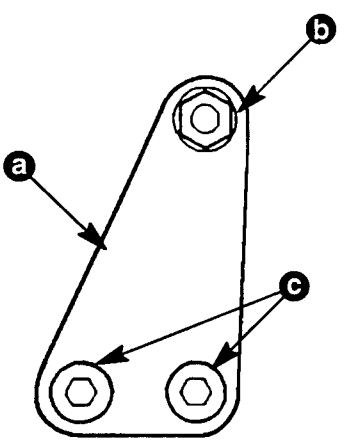
For Standard Left Hand Rotation – shift cable hookup at remote control must result in shift cable end guide moving in direction "B", when remote control handle is placed in forward position.

For Right Hand Rotation – shift cable hookup at remote control must result in shift cable end guide moving in direction "A", when remote control handle is placed in forward position.



23242

1. Follow instructions "a" or "b":
   a. <u>On early style bracket:</u> Anchor stud for shift cable should be installed as shown.



71040

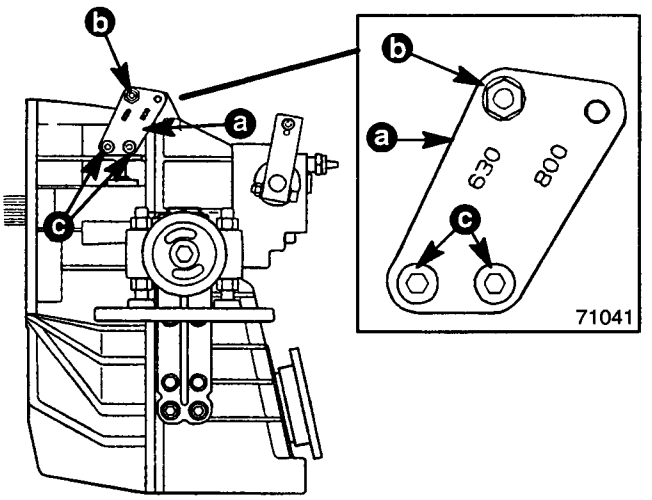
Early Style Shift Cable Bracket

a - Bracket, Shift Cable
b - Shift Cable Anchor Stud
c - Bracket-to-Transmission Fasteners

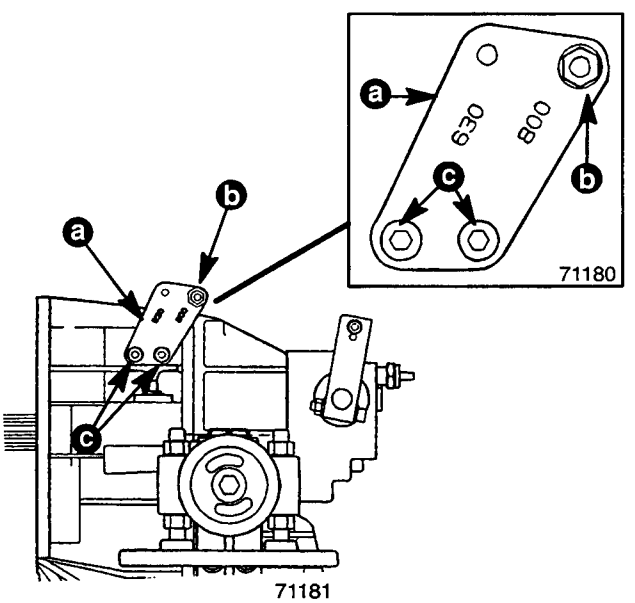
   b. <u>On late style bracket (with two anchor location holes):</u> Be certain anchor stud is installed in the hole marked appropriate for your transmission (Refer to Transmission Identification Plate for specific transmission model designation).

⚠WARNING

Avoid serious personal injury or property damage caused by improper shifting. Anchor stud for shift cable must be installed in the correct hole when using "late style" bracket.



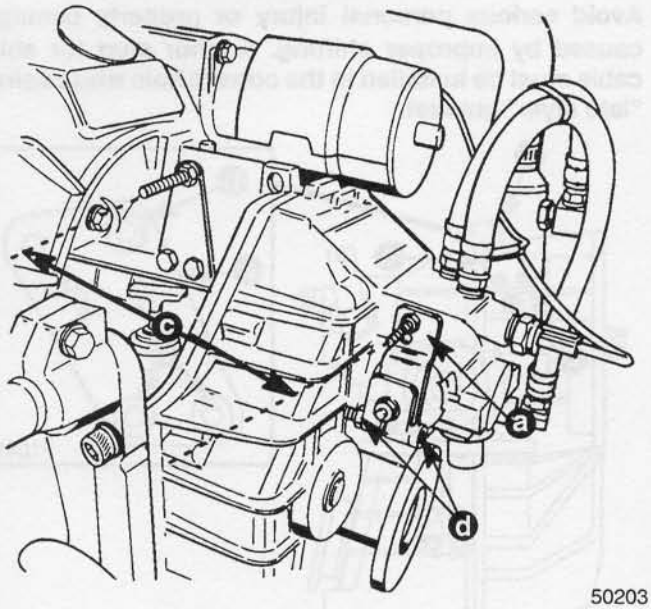
Late Style Shift Cable Bracket - Anchor Stud Position Shown for 630 Transmission



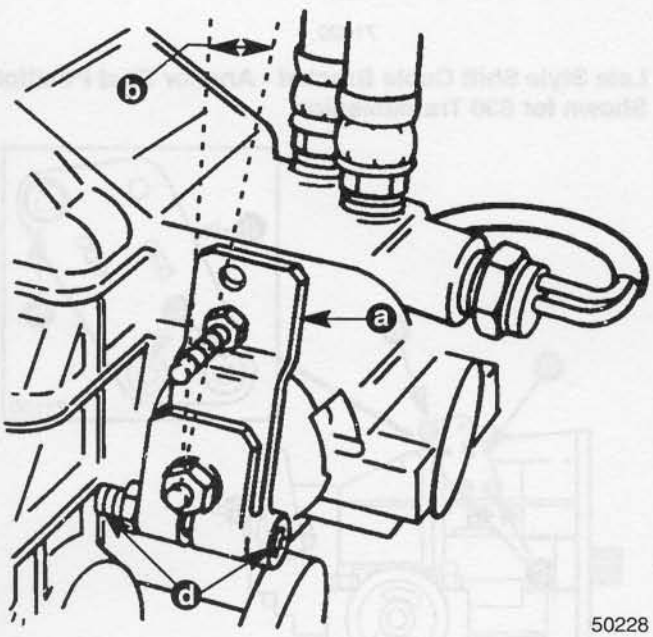
Late Style Shift Cable Bracket - Anchor Stud Position Shown for 800 Transmission

a - Bracket, Shift Cable
b - Shift Cable Anchor Stud
c - Bracket-to-Transmission Fasteners

IMPORTANT: Check that shift lever is positioned approximately 10° aft of vertical when in the neutral detent position and that the distance ("c") between studs in the following is set at 7-1/8 in. (318mm). If necessary, loosen clamping bolt and position lever so that dimension "c" is as shown when in the neutral detent position and retighten bolt.



50203

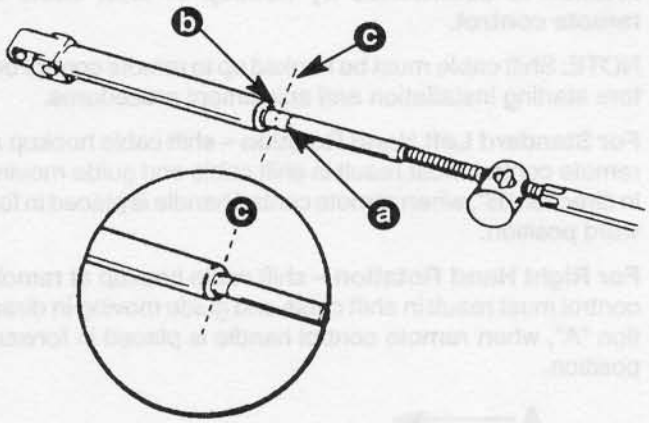


50228

a - Shift Lever
b - Lever, in Neutral Detent, Must Be Approximately 10 Degrees Aft of Vertical
c - Dimension Between Studs – 7-1/8 in. (318mm)
d - Clamping Bolt

Typical Hurth Transmission Shown

2. Place remote control shift lever, and transmission shift lever, in neutral position.
3. Remove nuts and washers from shift cable attaching studs.
4. Locate center of remote control and control shift cable play (backlash), as follows:
   a. Check that remote control is in neutral position.
   b. Push in on control cable end with enough pressure to remove play, and mark position "a" on tube.
   c. Pull out on control cable end with enough effort to remove play, and mark position "b" on tube.
   d. Measure distance between marks "a" and "b", and mark position "c", half-way between marks "a" and "b".

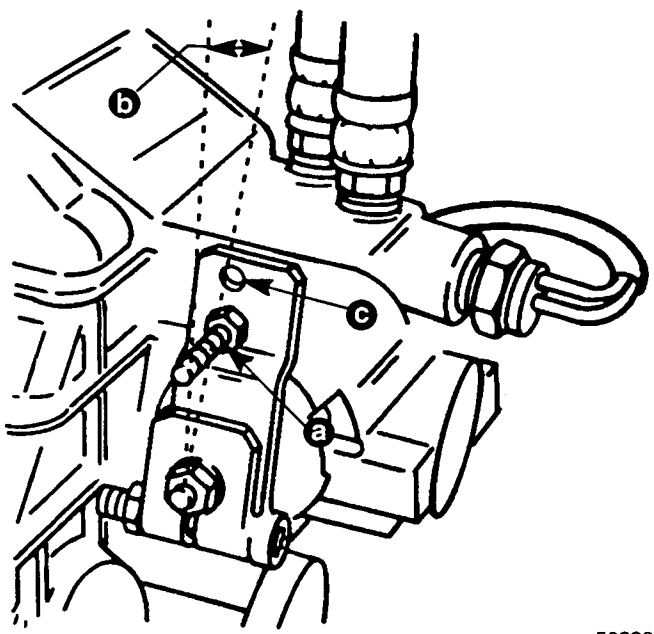


22024

5. Center cable-end play, then adjust cable barrel to align holes in barrel and in cable end guide with attaching points on transmission.
6. Temporarily install shift cable. Do not secure at this time.

IMPORTANT: Transmission is "fully" in gear when shift lever comes to a stop, in either direction.

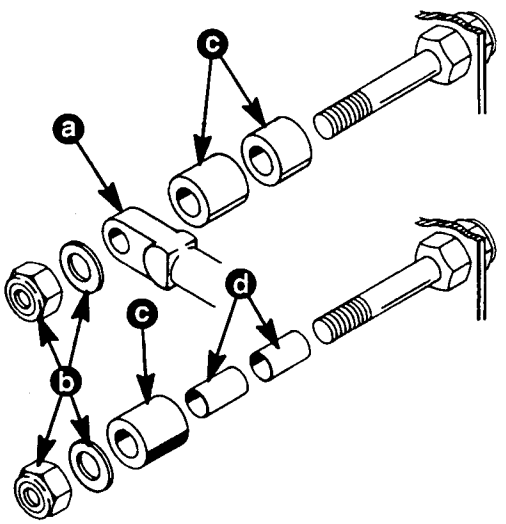
7. Place remote control shift lever in forward gear position. Check to ensure transmission is fully in gear, as follows:
   a. Hold shift lever in position.
   b. Carefully slide shift cable off of anchor points.
   c. Attempt to move shift lever further.
8. Place remote control shift lever in reverse gear position and again check to ensure transmission is fully in gear as follows:
   a. Hold shift lever in position.
   b. Carefully slide shift cable off of anchor points.
   c. Attempt to move shift lever further.
9. If transmission shift lever will position properly in one gear, but not in the other, recheck shift cable adjustment. If transmission shift lever will not position properly in both gears, move transmission shift lever stud (a), from top hole in shift lever, to bottom hole, and recheck for proper positioning. If proper positioning is still not obtained, remote control does not provide sufficient shift cable travel and must be replaced.



50228

a - Shift Lever Stud (in Bottom Hole, if Required)
b - Lever, in Neutral Detent, Must Be Approximately 10 Degrees Aft of Vertical
c - Shift Lever Top Hole

10. Install nut and washer to cable end guide stud. Tighten until snug, then back off one-full turn.
11. Install nut and washer to cable barrel stud. Tighten until they bottom out. Tighten securely, but do not over tighten.



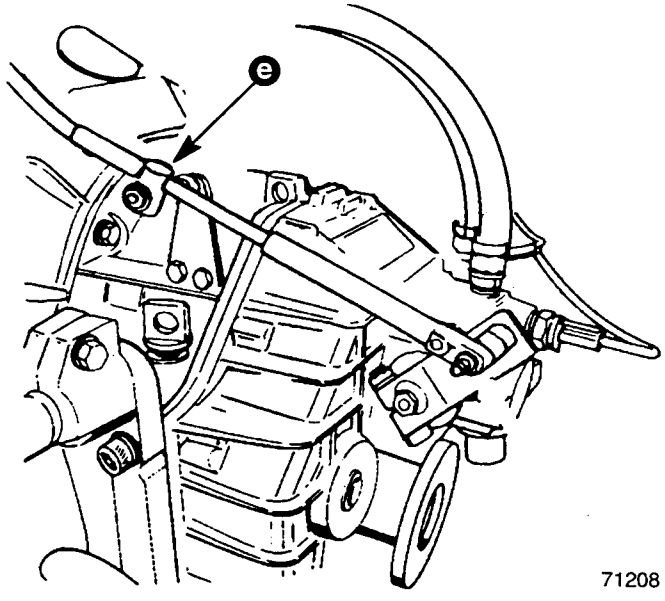
50229

a - Cable End Guide
b - Locknut and Washer
c - Spacer
d - Bushings
e - Cable Barrel

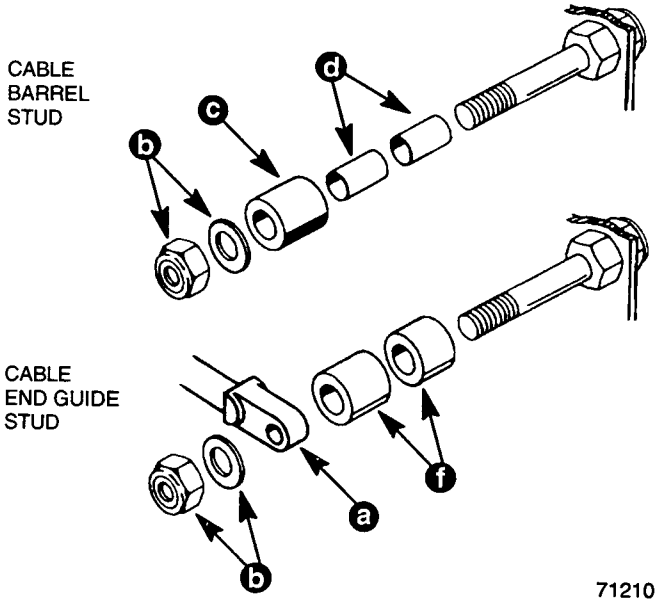
12. Once shift cable adjustment is correct, secure shift cable(s) with hardware as shown, referring to appropriate configuration following:

NOTE: To change cable approach direction on single or dual station installations, only the spacer/bushings have to be switched to the opposite stud (the studs are identical).

SINGLE CABLE - FORWARD ENTRY



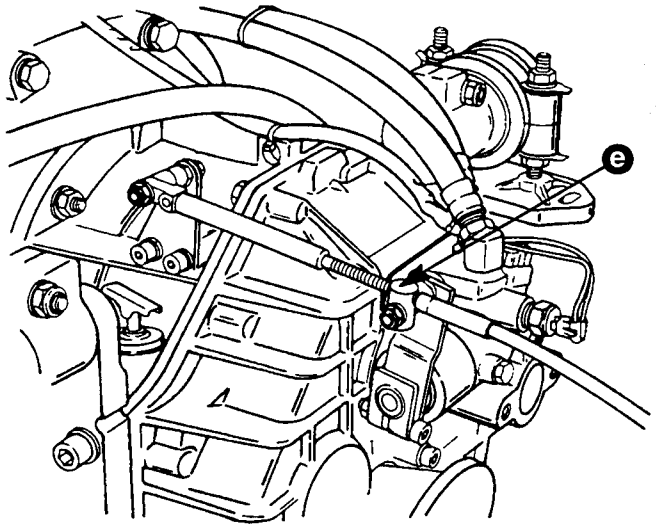
71208



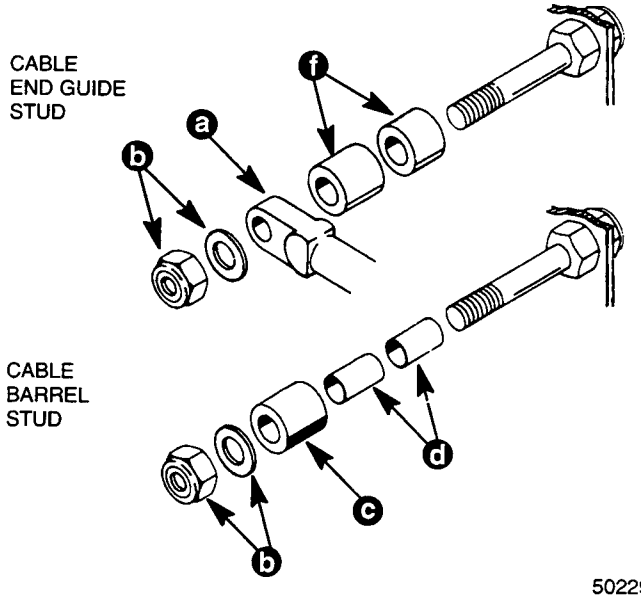
71210

a - Cable End Guide
b - Locknut and Washer (Tighten Until Bottomed, Then Back Off 1 Full Turn)
c - Spacer (Fits Over Bushings)
d - Bushings
e - Cable Barrel
f - Spacers (Fit Over Stud)

SINGLE CABLE - REAR ENTRY



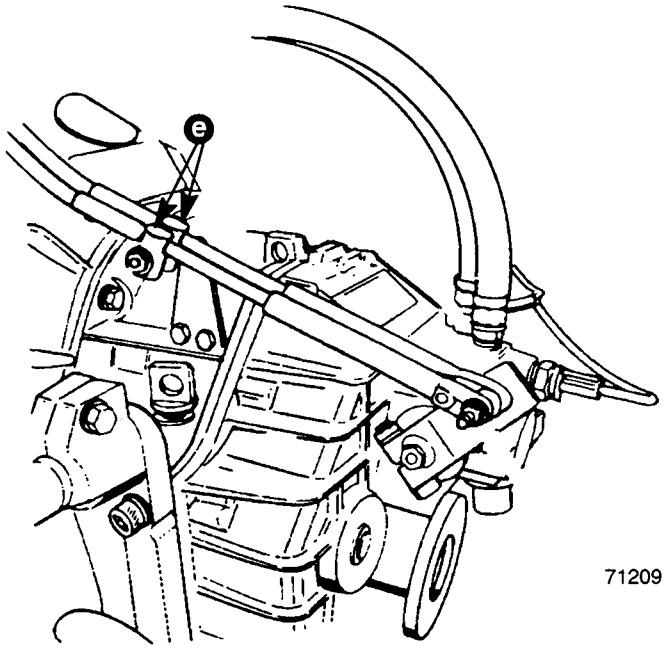
50759



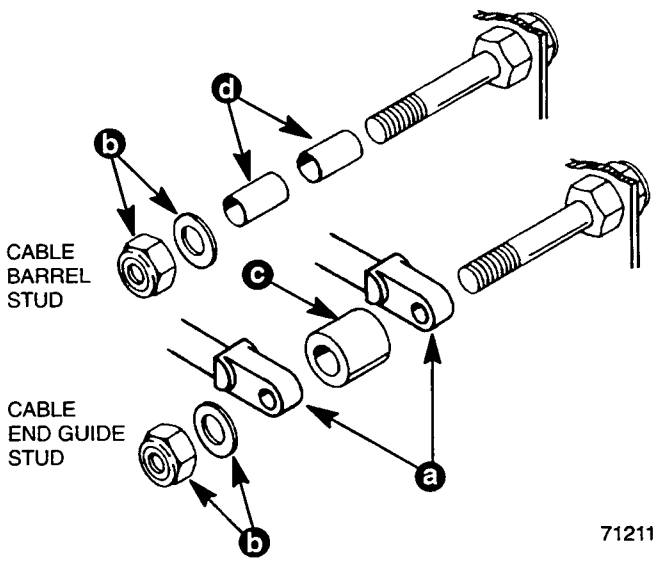
50229

a - Cable End Guide
b - Locknut and Washer (Tighten Until Bottomed, Then Back Off 1 Full Turn)
c - Spacer (Fits Over Bushings)
d - Bushings
e - Cable Barrel
f - Spacer (Fits Over Stud)

DUAL CABLE - FORWARD ENTRY



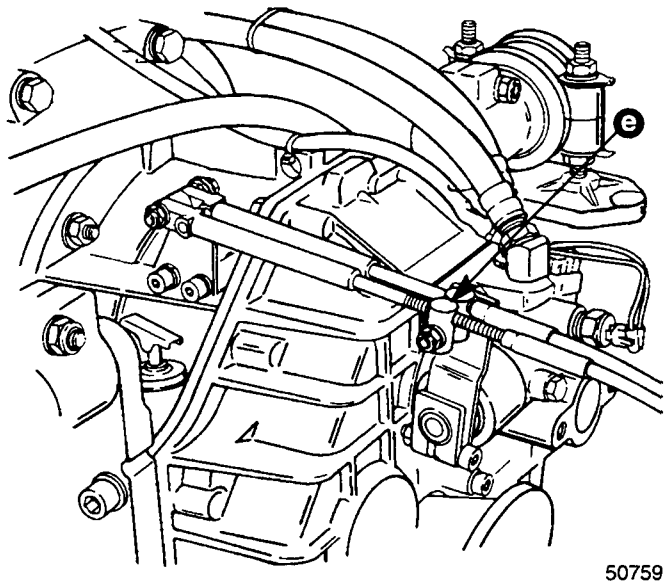
71209



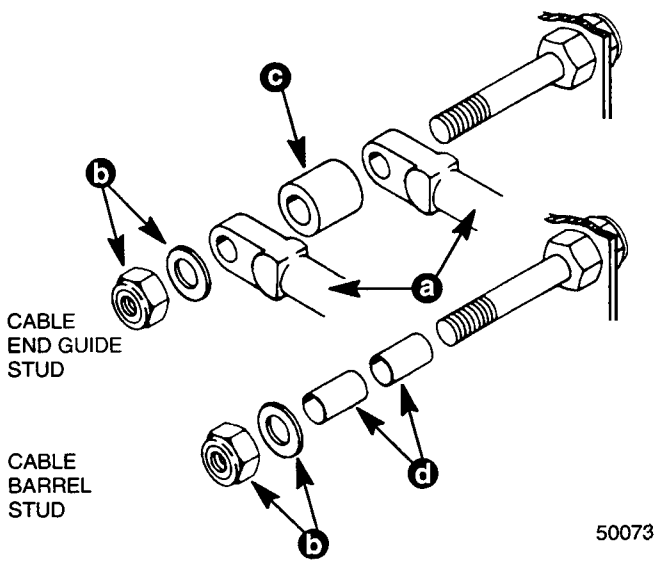
71211

a - Cable End Guides
b - Locknut and Washer (Tighten Until Bottomed, Then Back Off 1 Full Turn)
c - Spacer (Fits Over Stud)
d - Bushings
e - Cable Barrels

SINGLE CABLE - REAR ENTRY



50759



50073

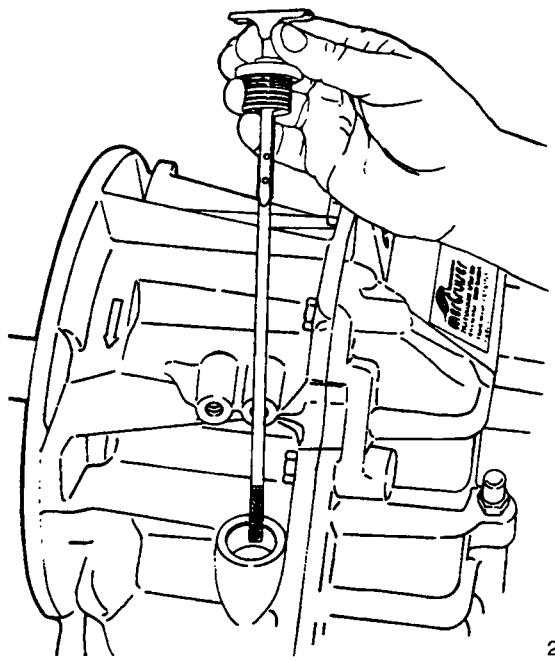
a - Cable End Guides
b - Locknut and Washer (Tighten Until Bottomed, Then Back Off 1 Full Turn)
c - Spacer (Fits Over Stud)
d - Bushings
e - Cable Barrels

Checking Transmission Fluid Level

IMPORTANT: Use only specified transmission fluid (see "Specifications").

Check transmission fluid before starting engine each day, as follows:

1. Remove dipstick. Check fluid level as indicated on dipstick. Fluid level may be somewhat over full mark, as some of the fluid from transmission fluid cooler and hoses may have drained back into transmission. If low, add transmission fluid to bring level up to full mark on dipstick.



27661

Typical Hurth Transmission Shown

IMPORTANT: To accurately check fluid level, engine must be run at 1500 RPM for 2 minutes immediately prior to checking level.

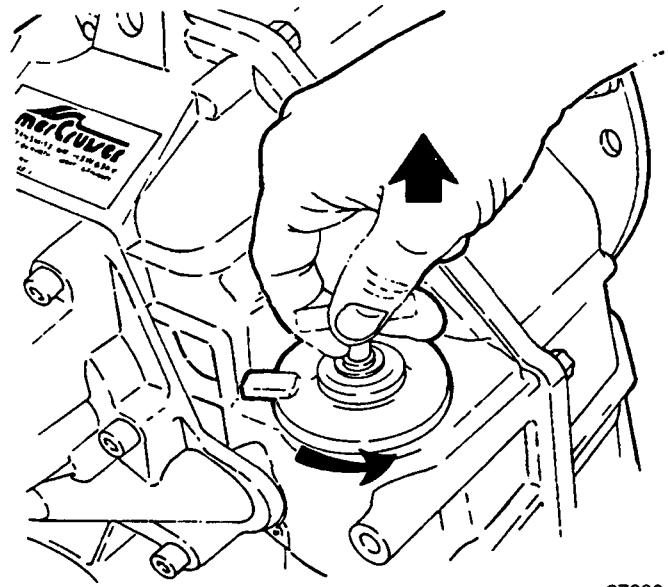
2. Start engine and run at 1500 RPM for 2 minutes to fill all hydraulic circuits.

IMPORTANT: Be sure to push dipstick all-the-way down into dipstick tube when checking fluid level.

3. Stop engine and quickly check fluid level. Add automatic transmission fluid, if necessary, to bring level up to full mark on dipstick. (Refer to "Filling Instructions," following.)
4. Reinstall dipstick.
5. If transmission fluid level was extremely low, carefully check transmission, fluid cooler and hoses for leaks.

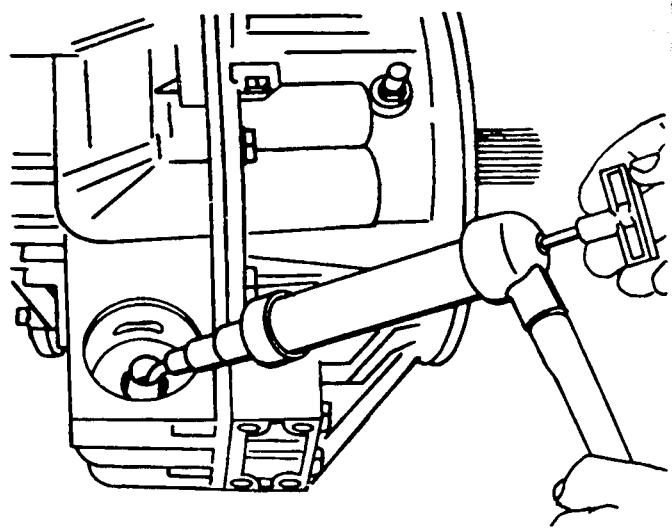
Draining Transmission

1. Clean the exterior of transmission before disassembly.
2. Remove oil filter from housing by turning (counter-clockwise) and pulling at the same time.



27666

3. Push hose of suction pump through suction pipe and down to the bottom of the housing. Pump fluid from housing.



71043

Checking Transmission Fluid Level

IMPORTANT: Use only specified transmission fluid (see "Specifications").

Check transmission fluid before starting engine each day, as follows:

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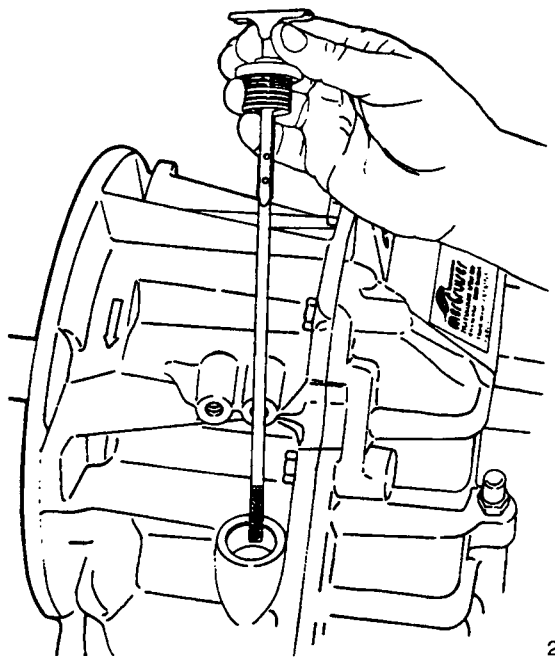

27661

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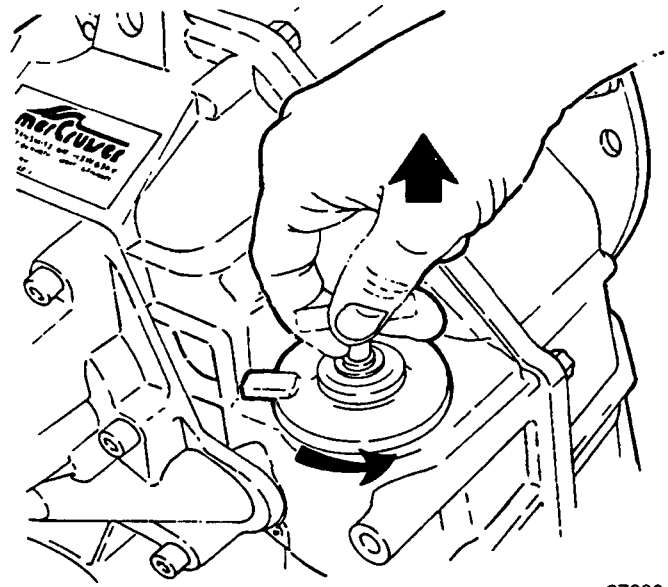

27666

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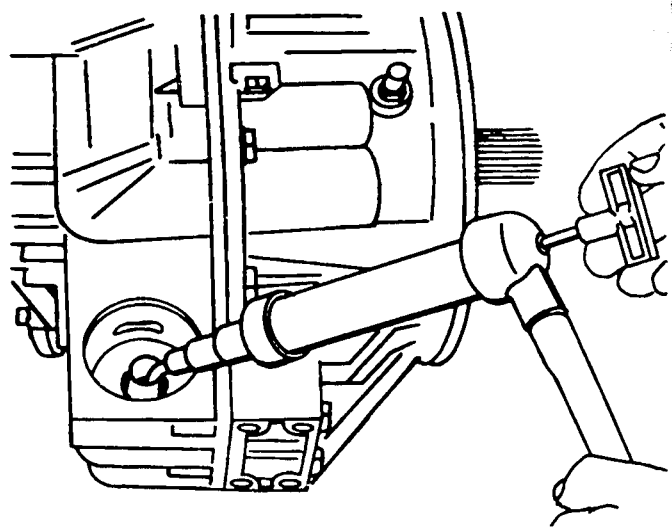
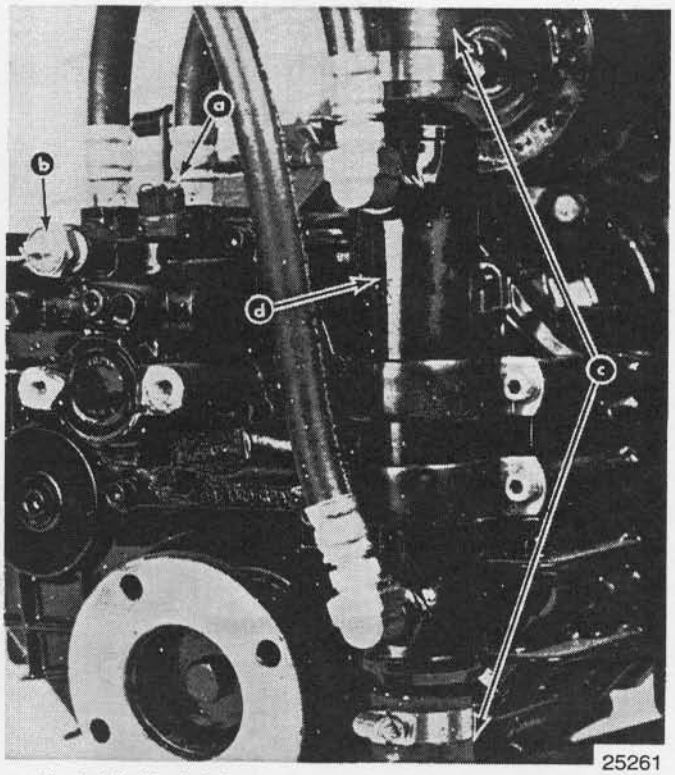


71043

Transmission Removal

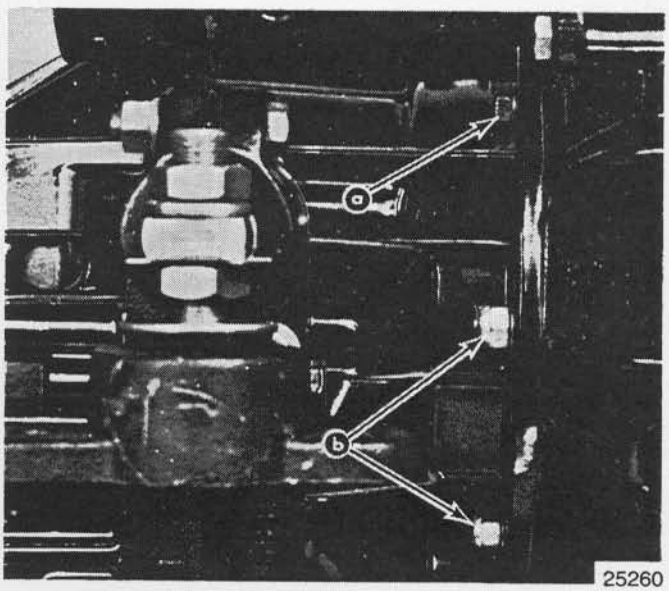
1. Disconnect wires from neutral safety switch and audio warning temperature switch.
2. Disconnect seawater hoses from transmission fluid cooler.



25261

a - Neutral Safety Switch
b - Audio Warning Temperature Switch
c - Seawater Hoses
d - Transmission Fluid Cooler

3. Remove bolts (2) and locknuts (4) and remove transmission.

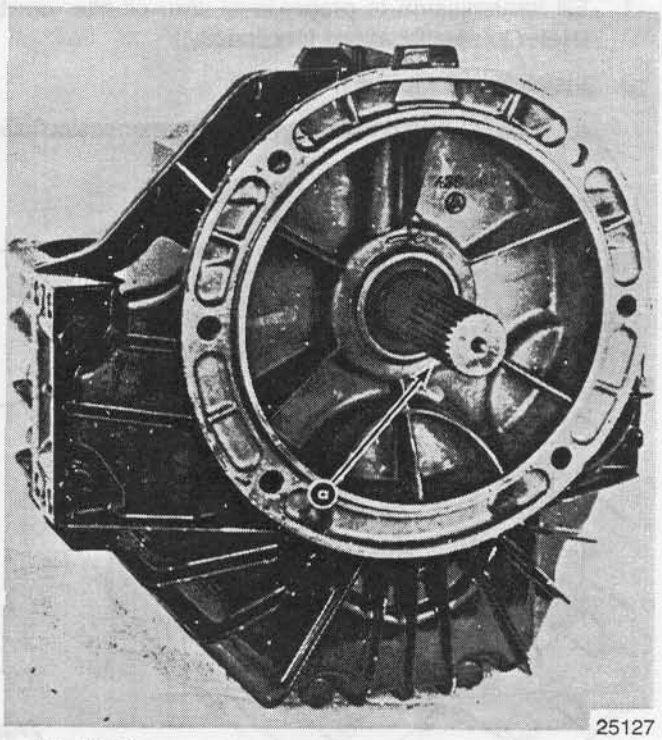


25260

a - Bolts [(2) One On Each Side]
b - Locknuts [(4) Two On Each Side]

Transmission Installation

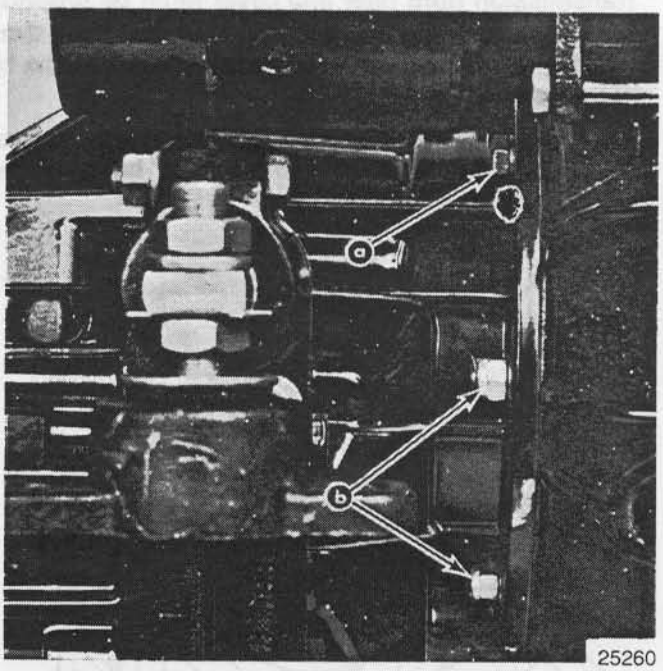
1. Coat splines on input shaft with 2-4-C Marine Lubricant.



25127

a - Input Shaft

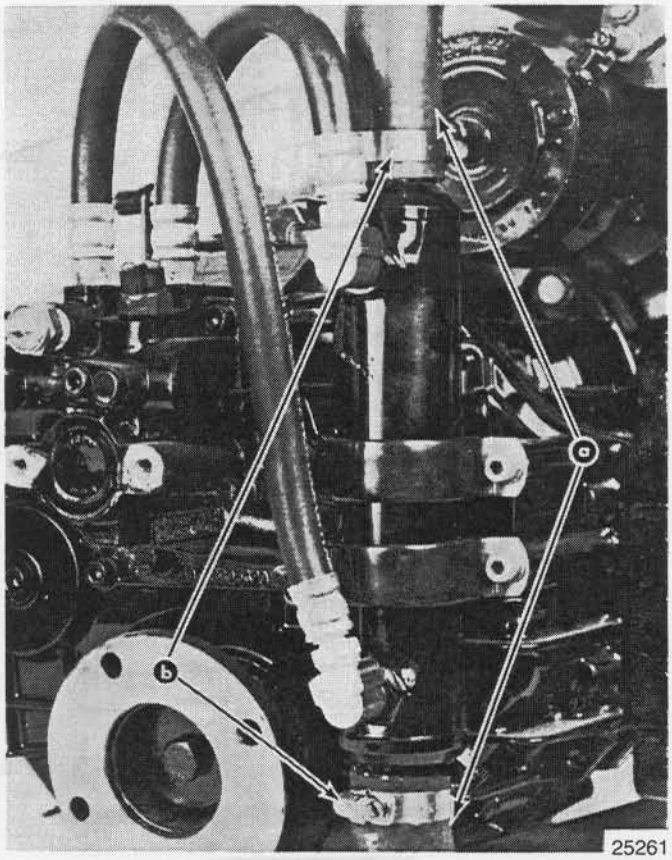
2. Install transmission on flywheel housing and secure with hardware shown. Torque fasteners to 50 lb. ft. (68 N·m).



25260

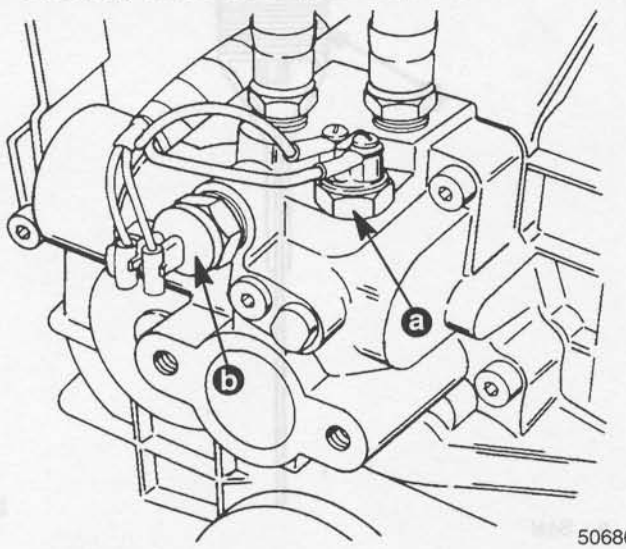
a - Bolts [(2) One On Each Side]
b - Locknuts [(4) Two On Each Side]

3. Connect seawater hoses to transmission fluid cooler and tighten hose clamps securely.



a - Seawater Hoses
b - Hose Clamps

4. Connect wires to neutral safety switch and to audio warning temperature switch. Coat connections on neutral safety switch with Liquid Neoprene.



a - Neutral Safety Switch
b - Audio Warning Temperature Switch

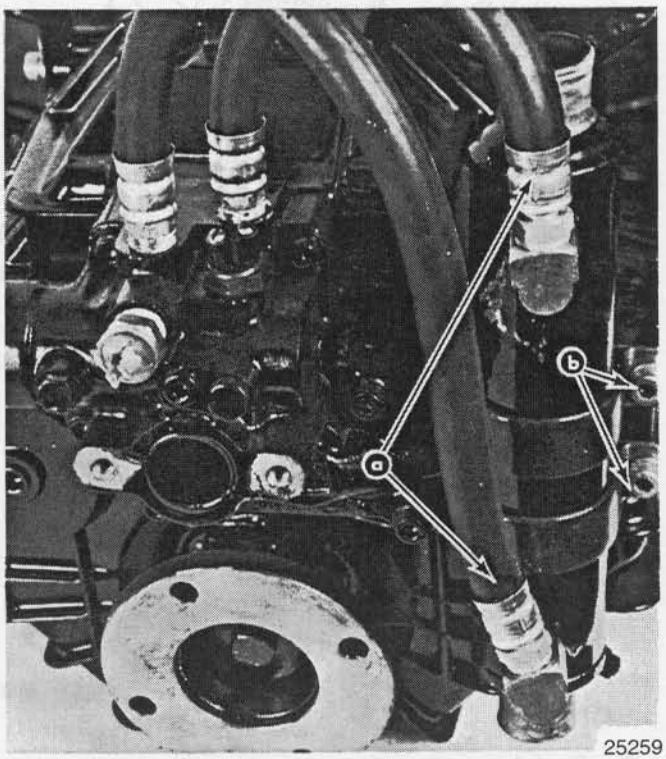
Transmission Repair

DISASSEMBLY

IMPORTANT: Ensure work area is clean before disassembly is started. Be sure to use lint free cloths when cleaning and/or handling parts.

Transmission Fluid Cooler

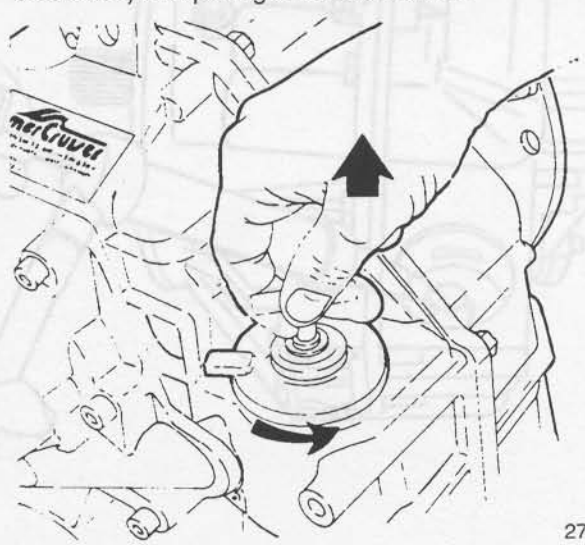
1. Disconnect transmission fluid hoses from cooler and remove clamps that secure cooler to housing.



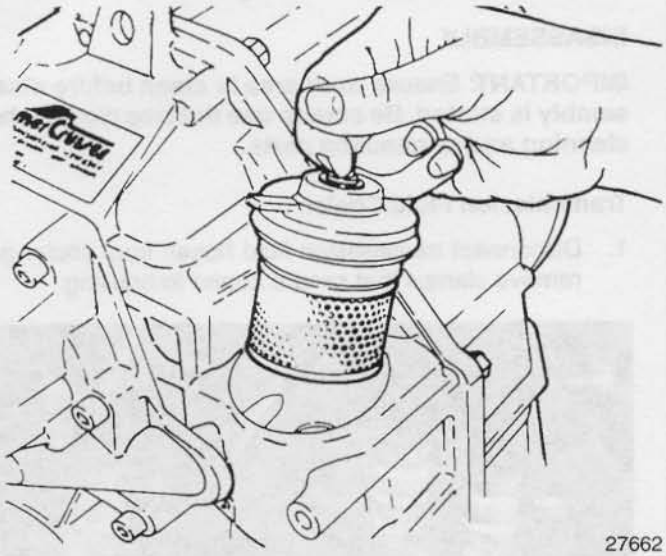
a - Transmission Fluid Hoses
b - Clamps

Oil Filter and Dipstick

2. Remove oil filter from housing by turning (counterclockwise) and pulling at the same time.

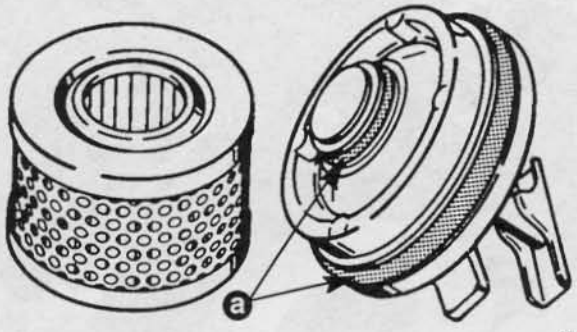


3. Remove cover and filter element from transmission.



27662

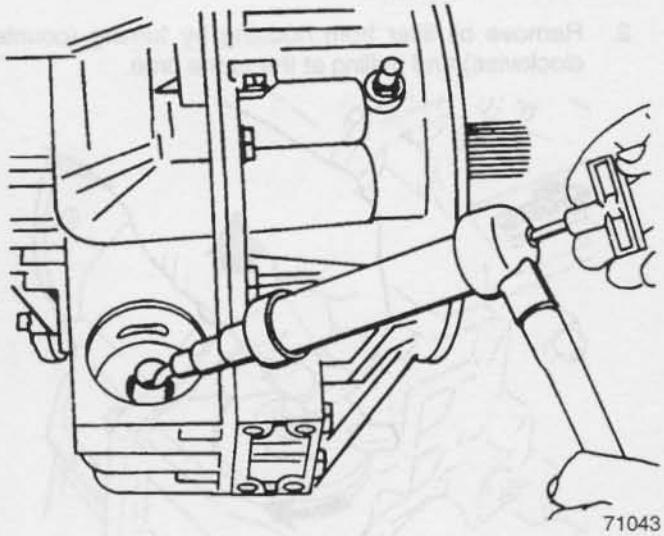
4. Remove filter element from cover and inspect O-rings for wear. Replace if necessary.



50975

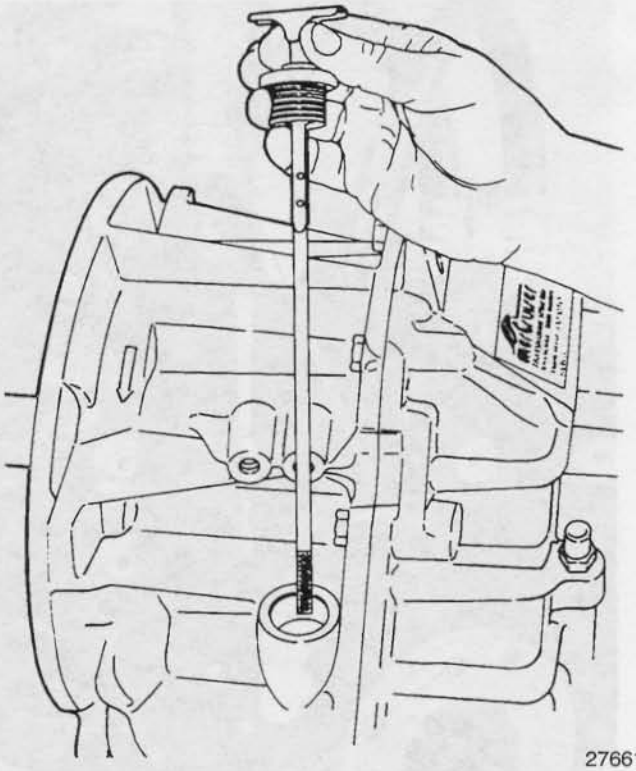
a - O-rings

5. Push hose of suction pump through suction pipe and down to the bottom of the housing. Pump fluid from housing.



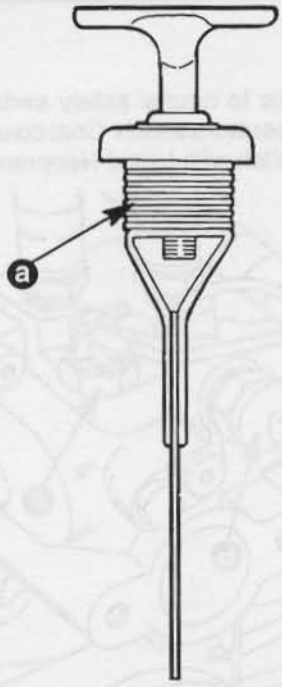
71043

6. Remove dipstick by turning (counterclockwise) and pulling at the same time.



27661

7. Inspect seal for wear and replace if necessary.

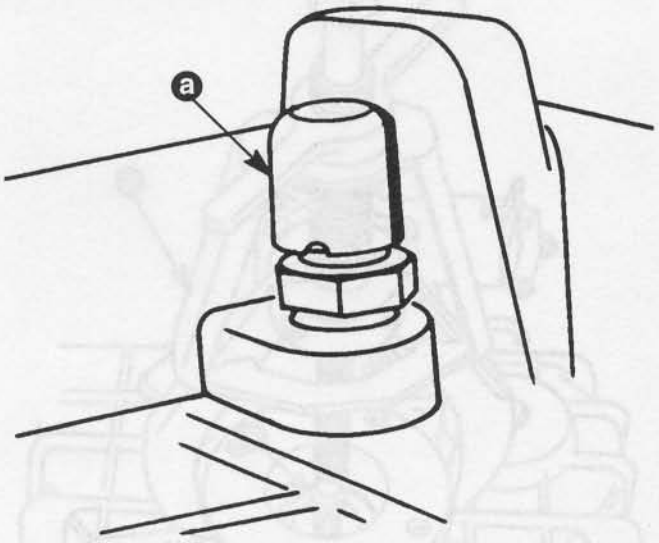


27659

a - Seal

BREATHER VALVE

8. Remove breather valve. Clean with suitable cleaner, allow to dry and coat with oil.

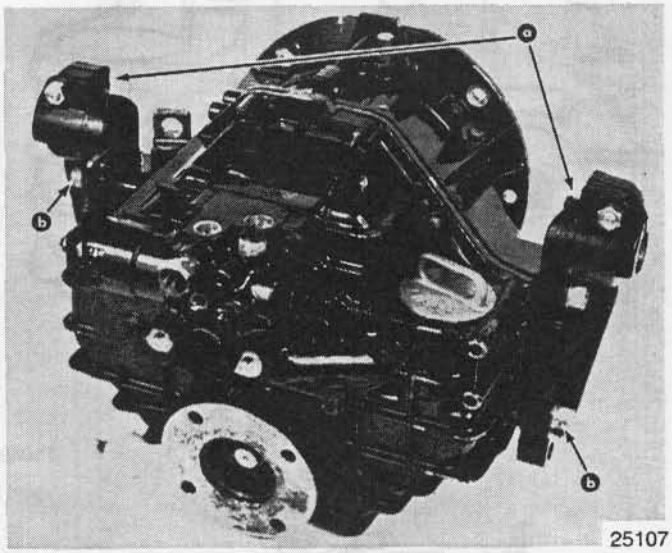


71048

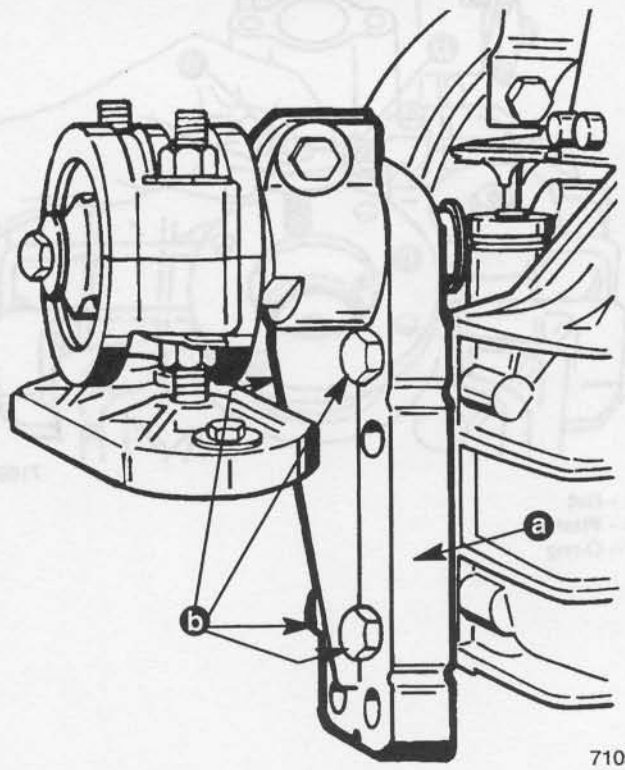
a - Breather Valve

Mounts

9. Remove mounts from transmission housing. Inspect mounts for damage and replace if necessary.



25107

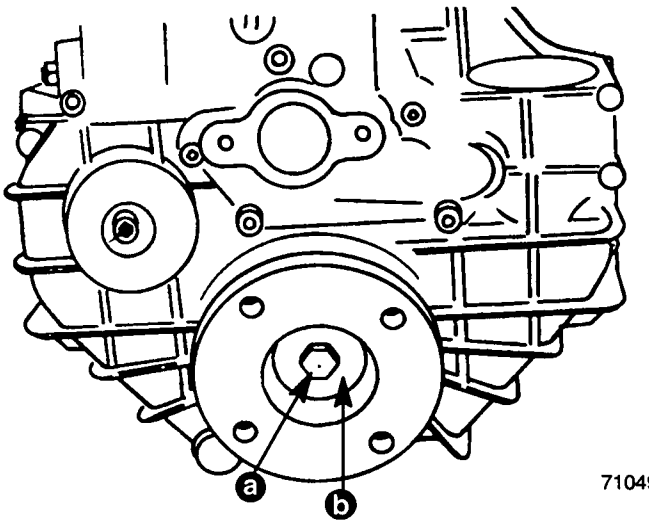


71052

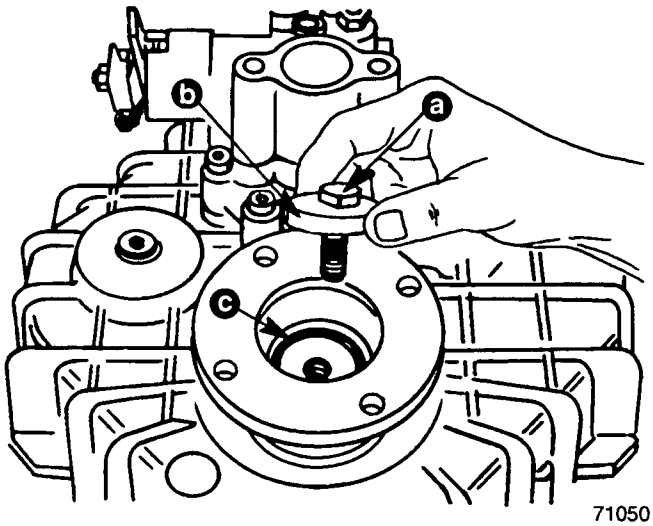
a - Transmission Mount
b - Retaining Screws (4 Total on Each Mount - One Hidden In This View)

OUTPUT FLANGE

10. Remove bolt, washer and O-ring.



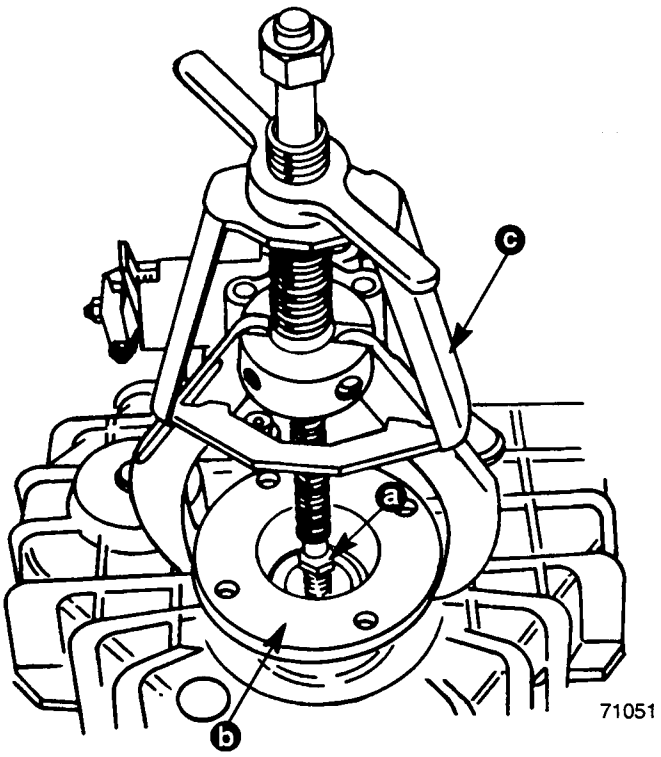
71049



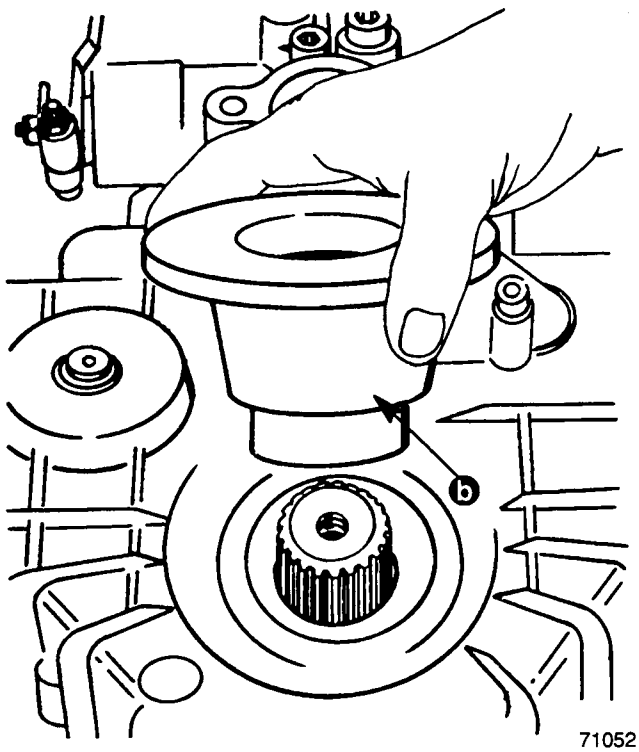
71050

a - Bolt
b - Washer
c - O-ring

11. Reinstall bolt and remove flange using appropriate puller.



71051

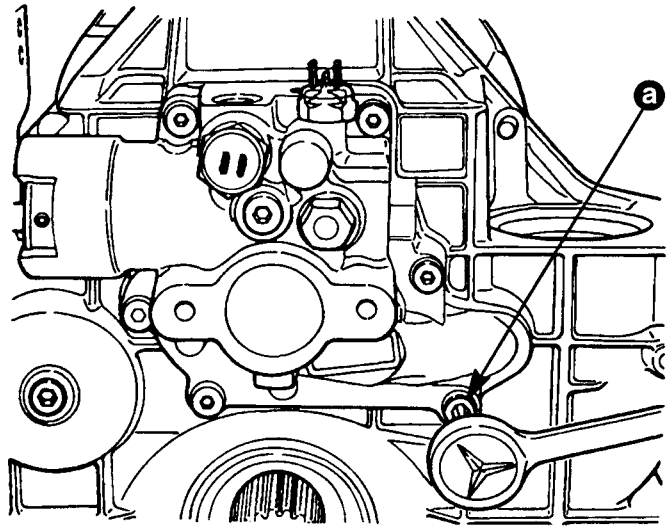


71052

a - Bolt
b - Flange
c - Puller

CONTROL BLOCK

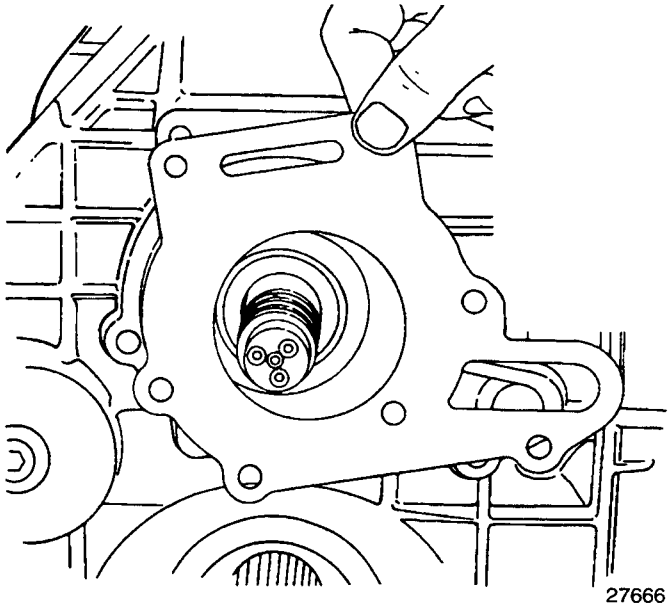
12. Remove hex head bolts (6).



27661

a - Hex Head Bolts (6)

13. Remove control block and gasket from housing.

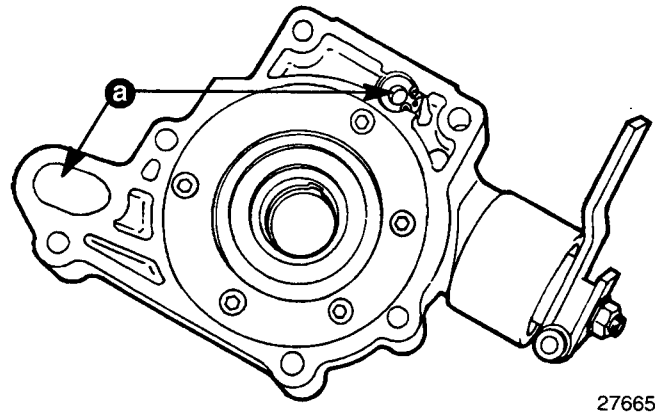


27666

⚠CAUTION

Be careful not to allow dirt to enter control block from front side.

14. Cover openings in control block with a protective cloth.

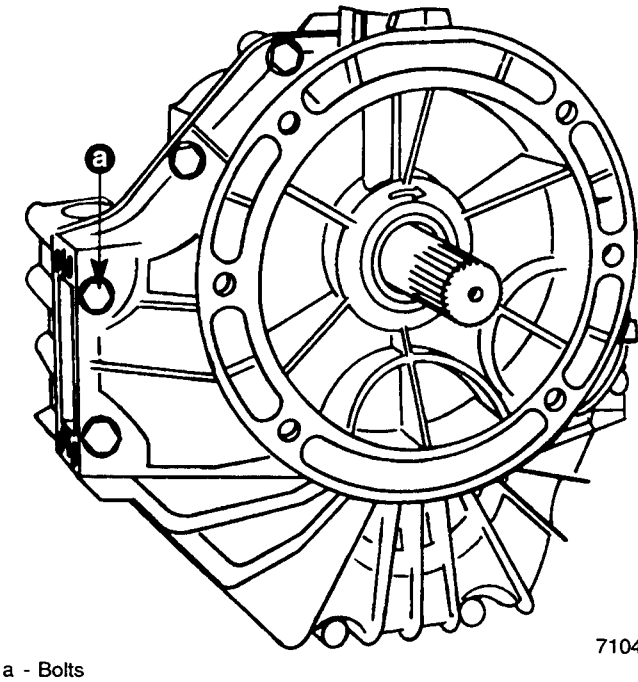


27665

a - Openings

HOUSING

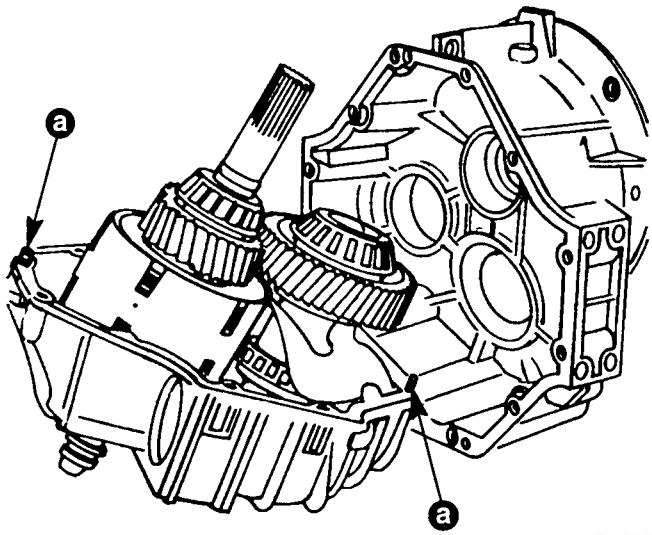
15. Remove hex head bolts (12) from input side of housing.



71044

a - Bolts

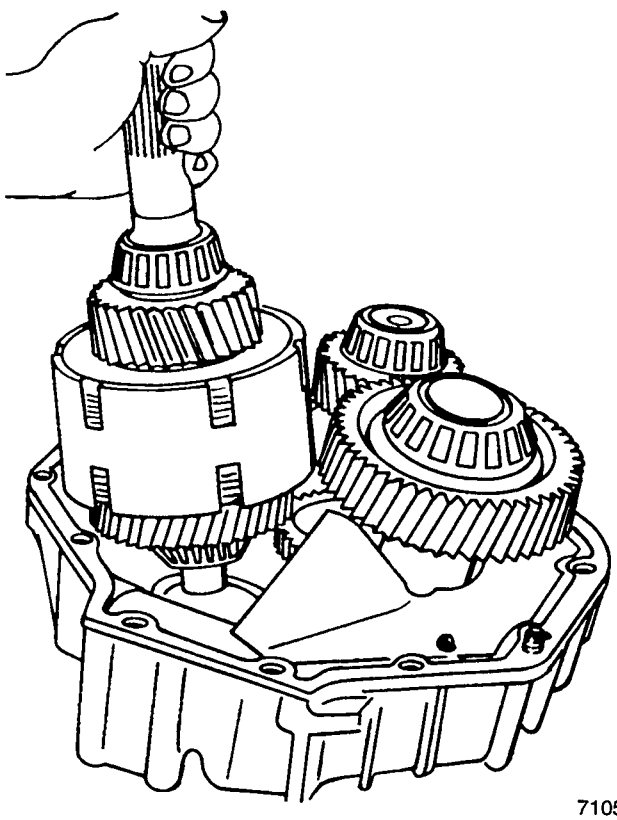
16. Remove input side of housing. Be sure to locate and save locator pins.



71053

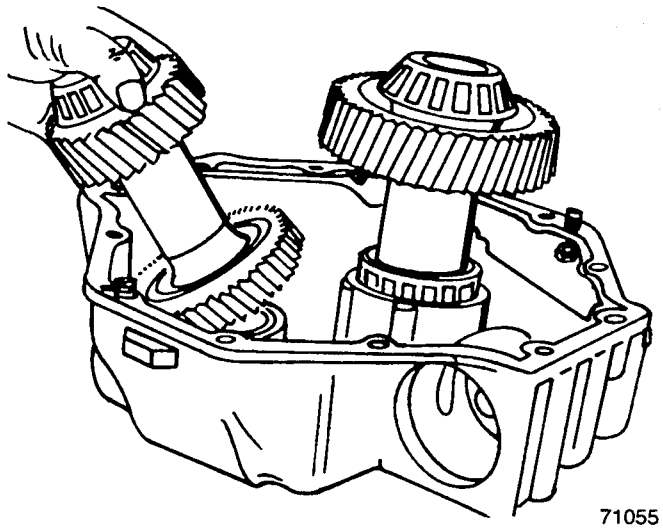
a - Locator Pins

17. Remove input shaft assembly.



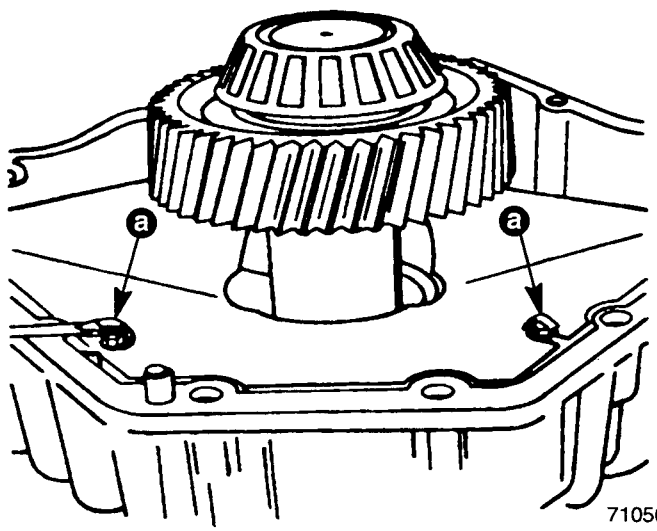
71054

18. Remove intermediate shaft assembly.

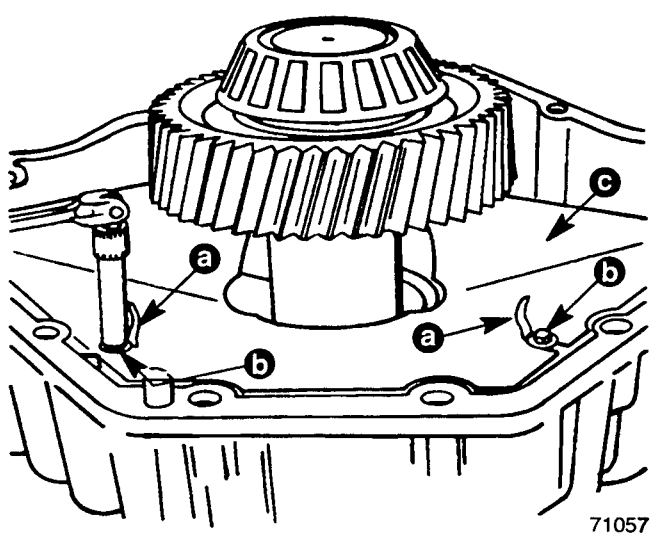


71055

19. Remove baffle plate as follows:
    a. Bend tabs up away from screws.
    b. Remove screws, then; remove baffle plate.



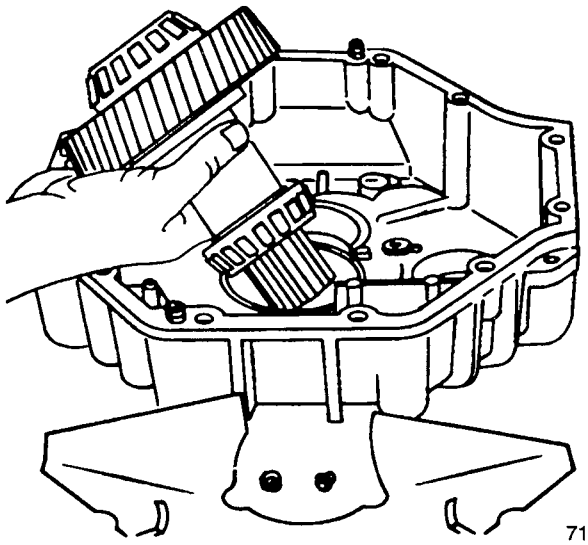
71056



71057

a - Tab
b - Screws
c - Baffle Plate

20. Remove output shaft assembly.



71058

BEARING, GEAR and SEAL INSPECTION

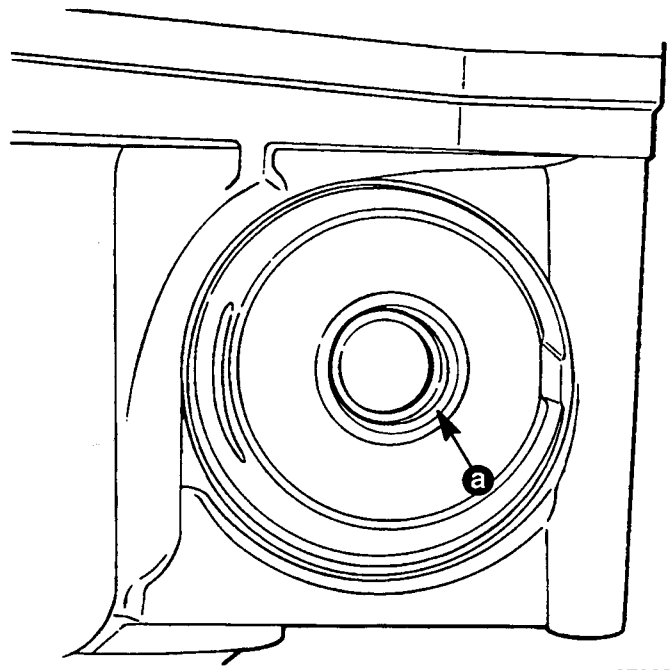
21. Inspect all tapered roller bearings, the piston rings on the input shaft and all gears for wear. If damage has been found on the gearing of the intermediate or output shaft, it is ALWAYS necessary to replace the complete shaft.

    When gears on the input shaft have to be replaced, the tapered roller bearings and needle bearings MUST BE replaced as well.

22. Turn gears of input shaft to check correct operation of the reversing clutch. If it is hard to turn the gears, the clutch is probably damaged.

SEALS

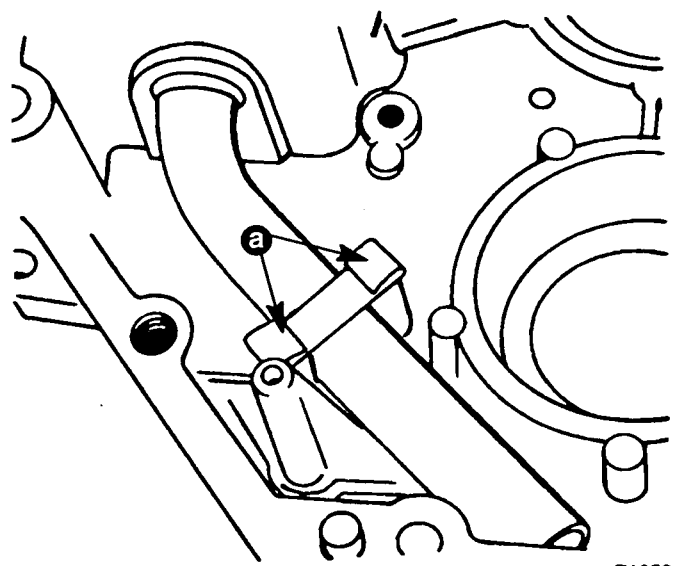
23. Remove suction pipe seal as follows:



27666

a - Seal

a. Bend tabs up away from screws.

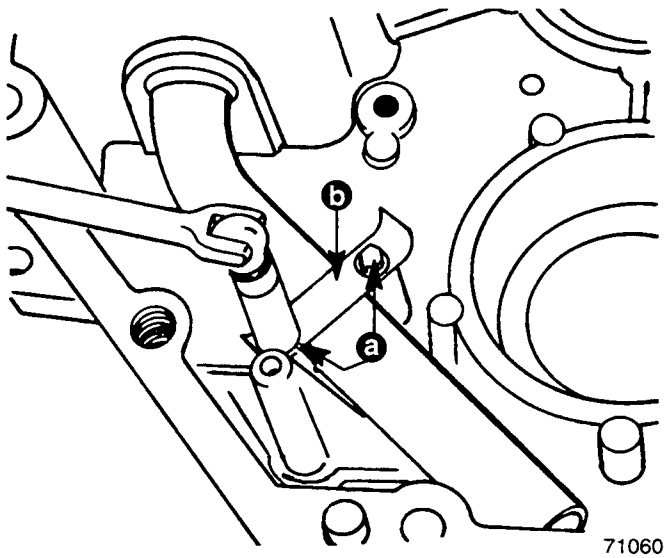


71059

a - Tabs

b. Remove screws and hold down plate.

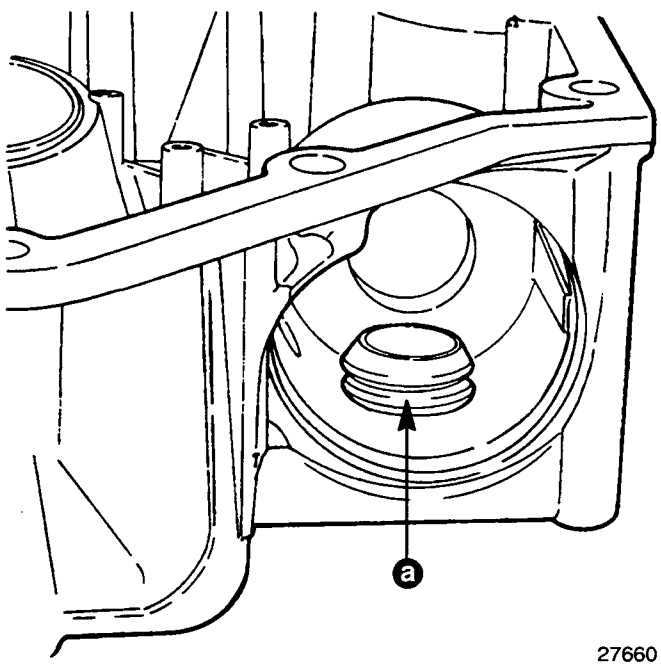
c. Remove suction pipe by pulling downward out of seal.



71060

a - Screws
b - Hold Down Plate

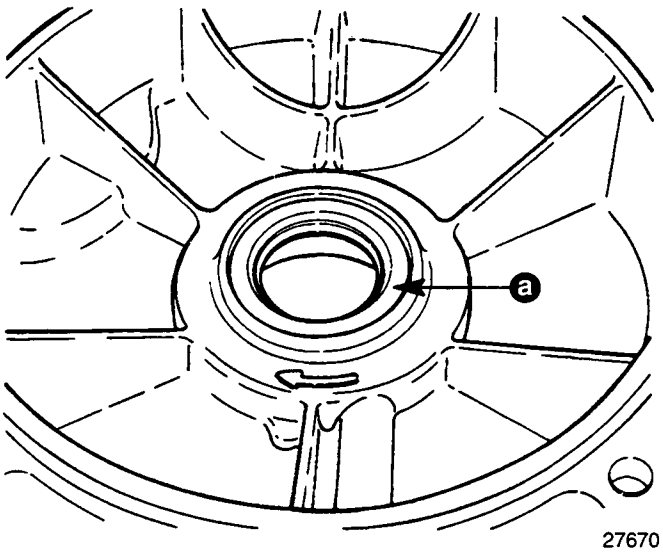
d. Remove seal from top side.



27660

a - Seal

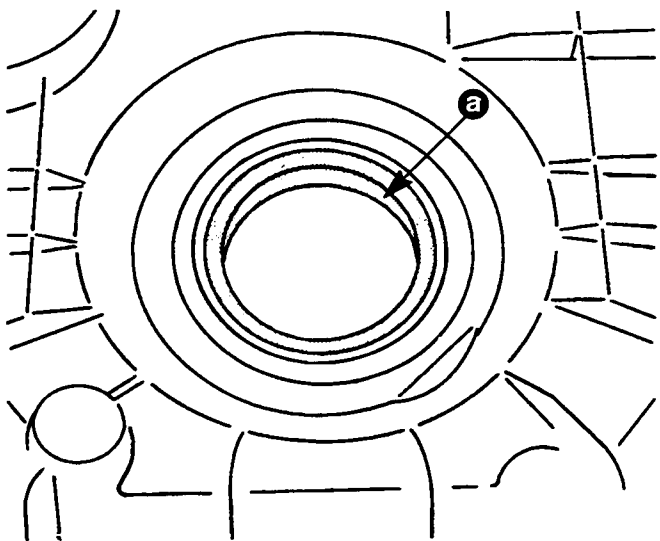
24. Remove input shaft seal using appropriate mandrel.



27670

a - Seal

25. Remove output shaft seals using appropriate mandrel.



71061

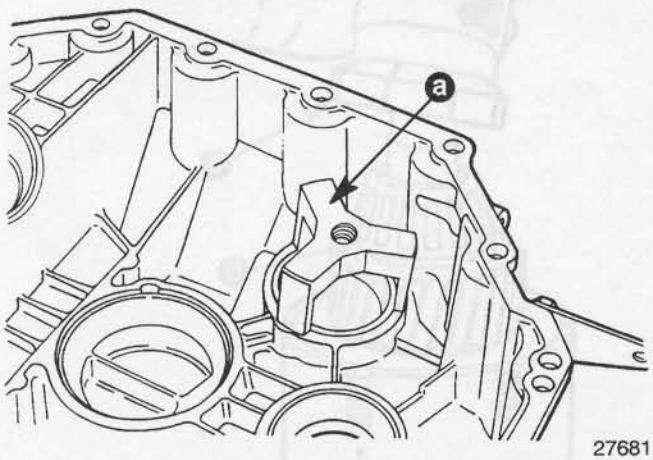
a - Seal

TAPERED ROLLER BEARING CUPS

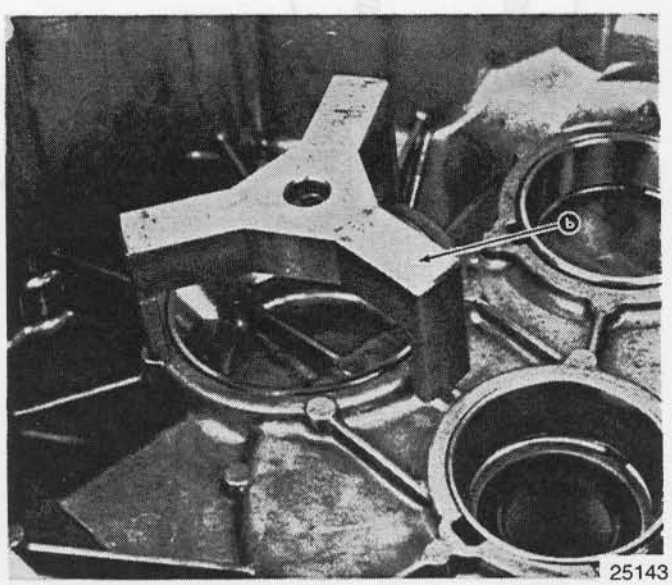
IMPORTANT: Do not remove tapered roller bearing cups unless replacing tapered roller bearings. Bearing and cup must be replaced as a set.

IMPORTANT: Do not mix up shims under cups on the input housing side. Shims are required for adjusting the bearing preload.

26. Pull tapered roller bearing cups from housing use special puller as follows:
    a. Position appropriate puller guide (large diameter or small diameter) over cup as shown.



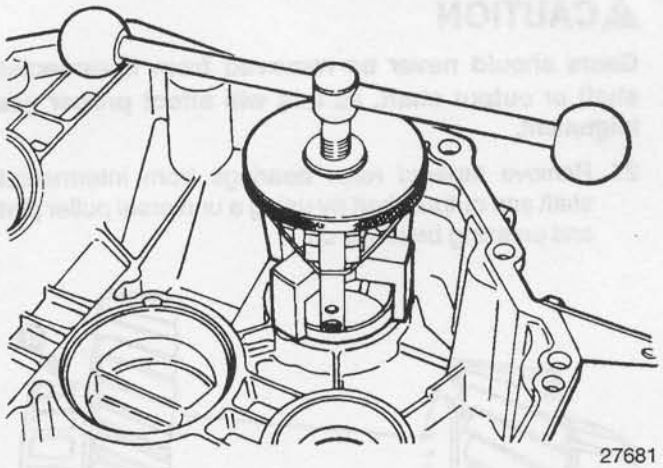
27681



25143

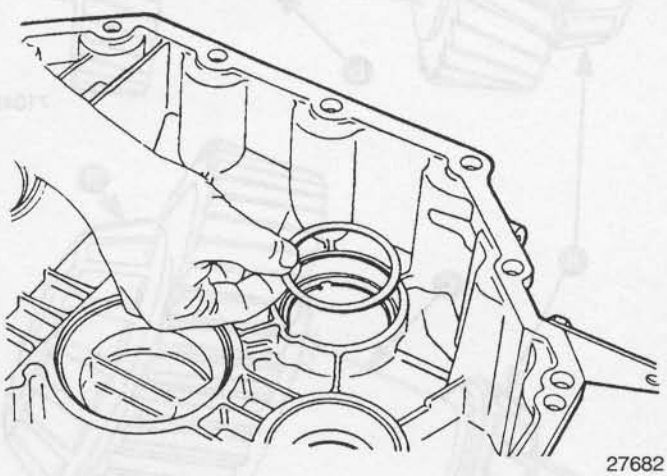
a - Small Diameter Puller Guide
b - Large Diameter Puller Guide

    b. Pull bearing cup from housing using tool as shown.



27681

    c. **Input Housing Side:** Remove and retain shims. DO NOT MIX UP.



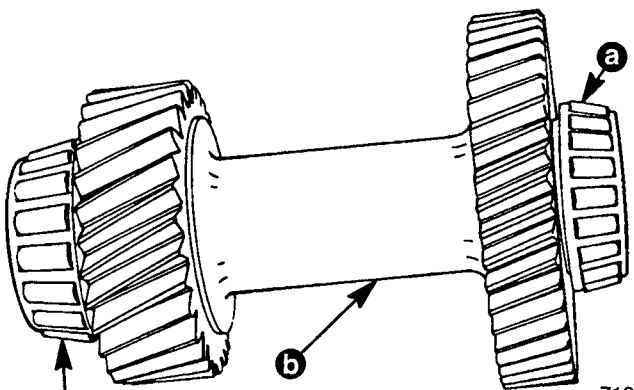
27682

TAPERED ROLLER BEARINGS

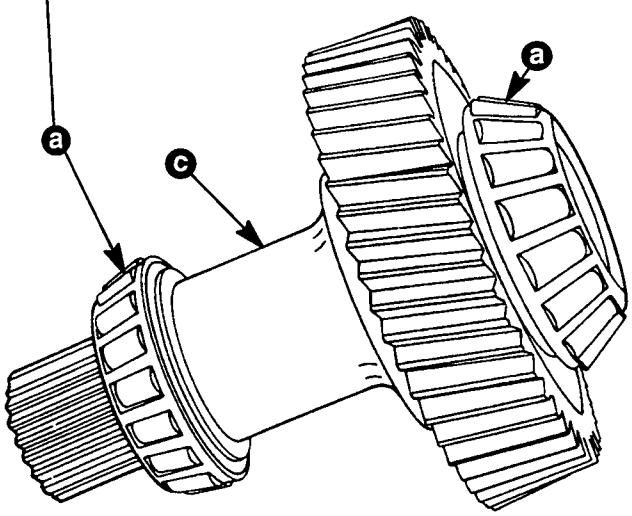
⚠CAUTION

Gears should never be removed from intermediate shaft or output shaft, as this will affect proper gear alignment.

27. Remove tapered roller bearings from intermediate shaft and output shaft by using a universal puller plate and pressing bearings off.



71045

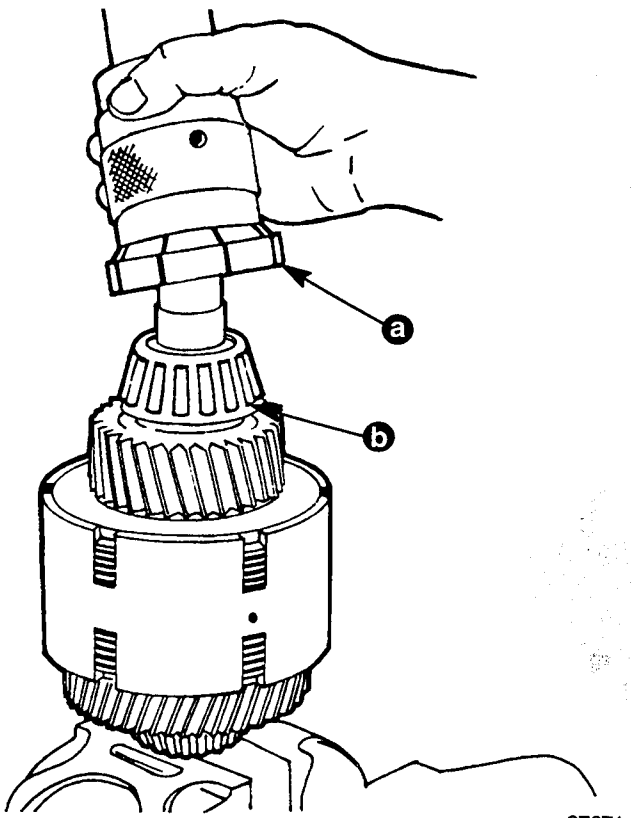


71046

a - Tapered Roller Bearing(s)
b - Intermediate Shaft
c - Output Shaft

REVERSING CLUTCH, GEARS and TAPERED ROLLER BEARINGS

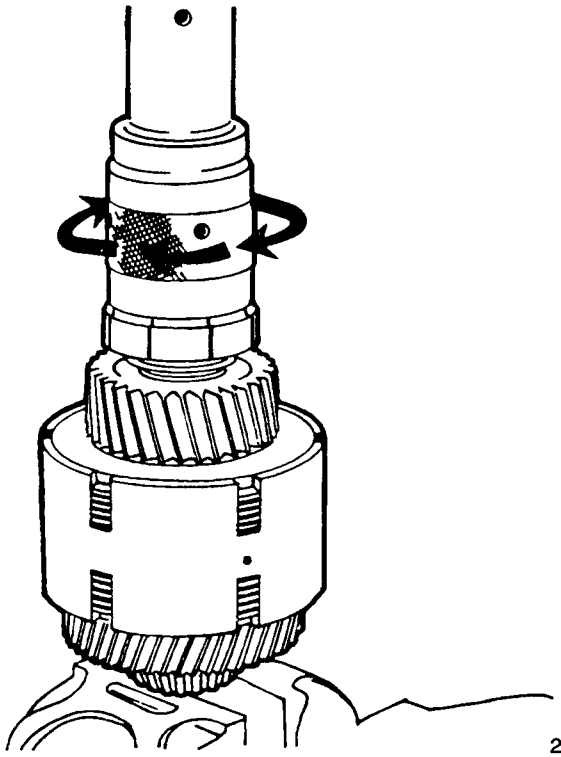
28. Remove tapered roller bearing from splined end of input shaft using special tool as follows:
    a. Place tool over tapered roller bearing. Ensure jaws of tool will be pulling on bottom edge of rollers and NOT on the cage.



27671

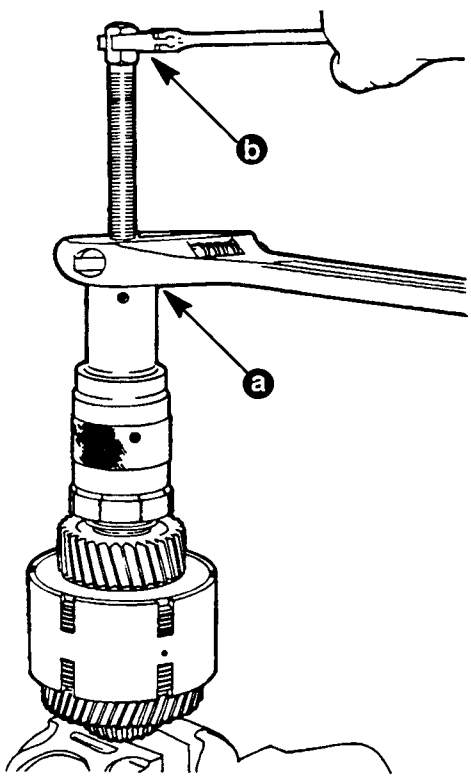
a - Jaws
b - Bottom Edge of Rollers

b. Tighten jaws onto bearing by turning on knurled part of tool. Tighten assembly.



27671

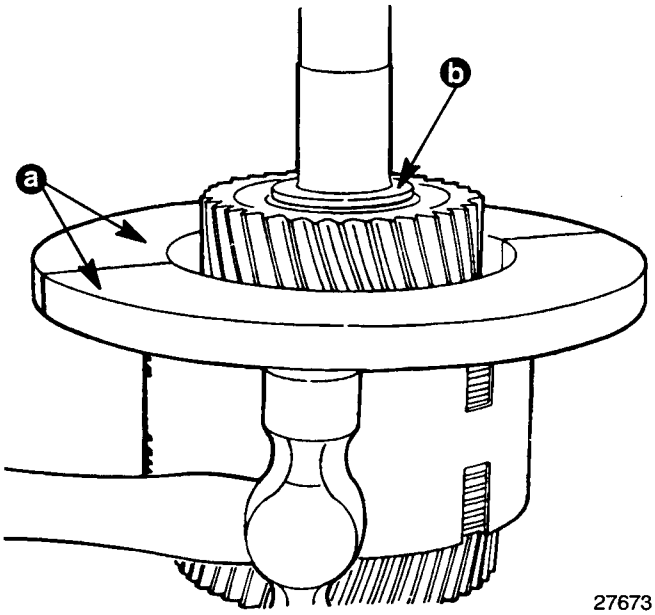
c. Pull tapered roller bearing from shaft using tool as shown.



27672

a - Hold Tool Stationary
b - Turn Top Nut

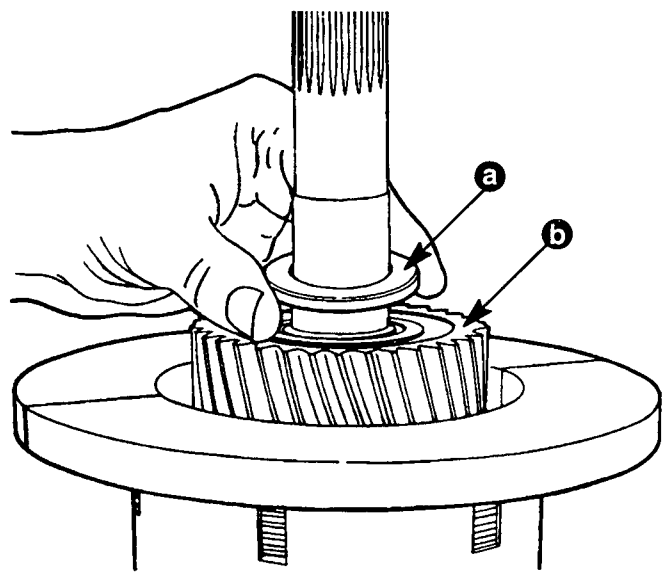
29. Remove butting ring from splined end of input shaft by installing special tool as shown and lightly tapping upward on tool.



27673

a - Special Tool
b - Butting Ring

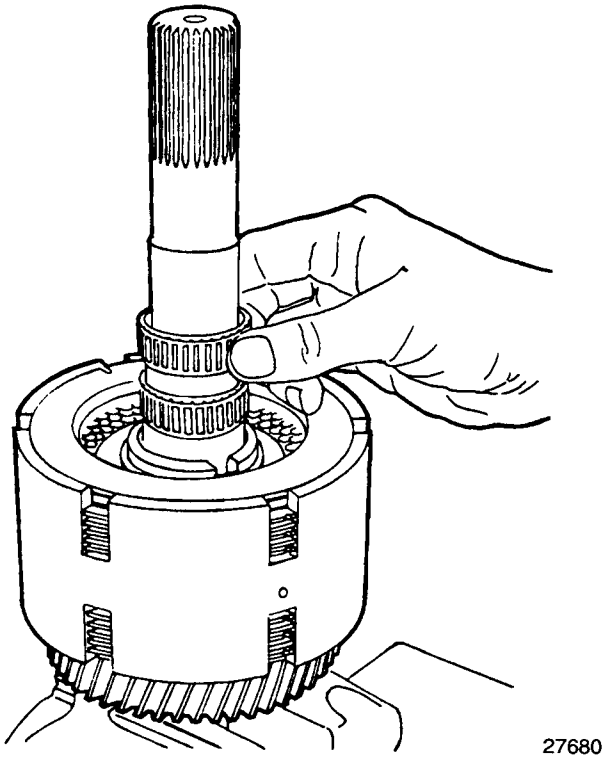
30. Remove butting ring and gear assembly.



27675

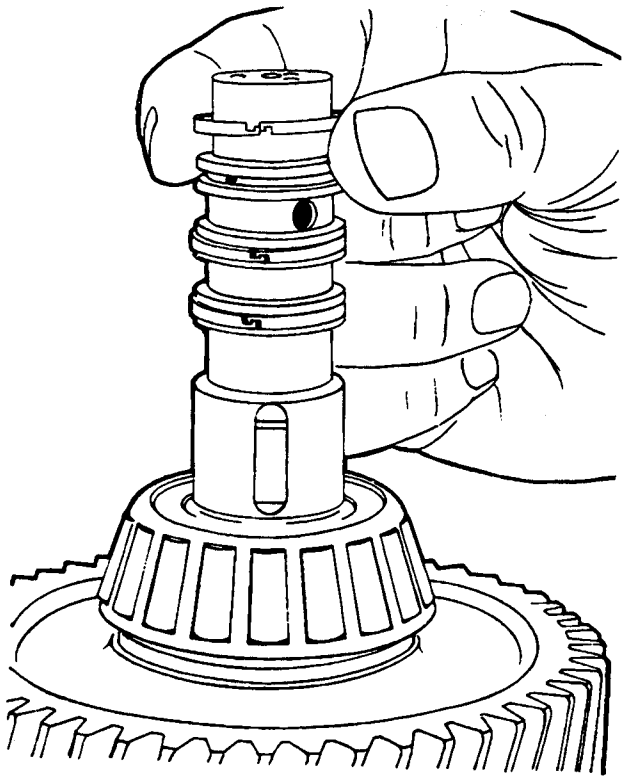
a - Butting Ring
b - Gear Assembly

31. Remove needle bearings.



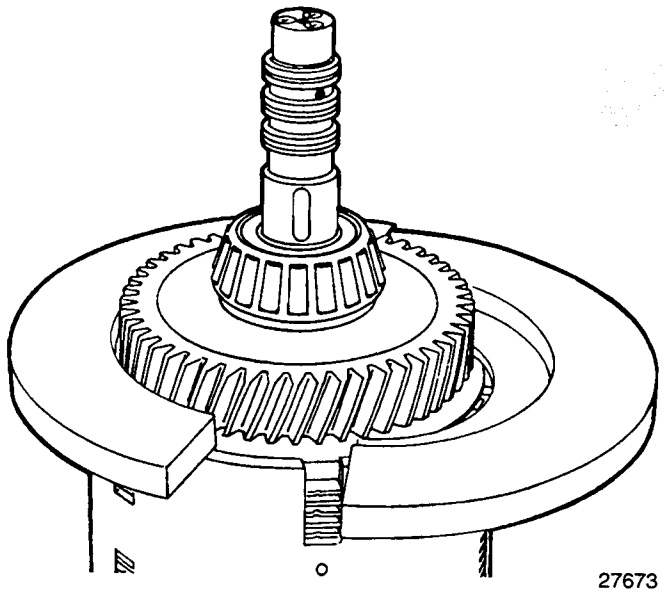
27680

32. Remove piston rings from shaft.



27679

33. Remove tapered roller bearing, butting ring and gear from piston end of shaft using special tool as shown. Press all components off at the same time. Then, remove needle bearings.

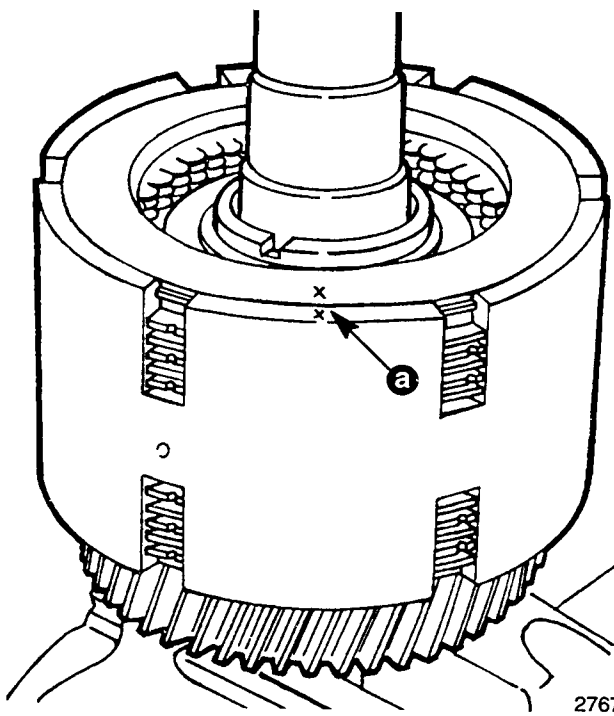


27673

CLUTCH DISCS

NOTE: Discs on both sides of clutch are removed in the same manner.

IMPORTANT: Reference marks are placed on the clutch housing and end disc to aid in locating the snap ring opening.



27675

a - Reference Marks

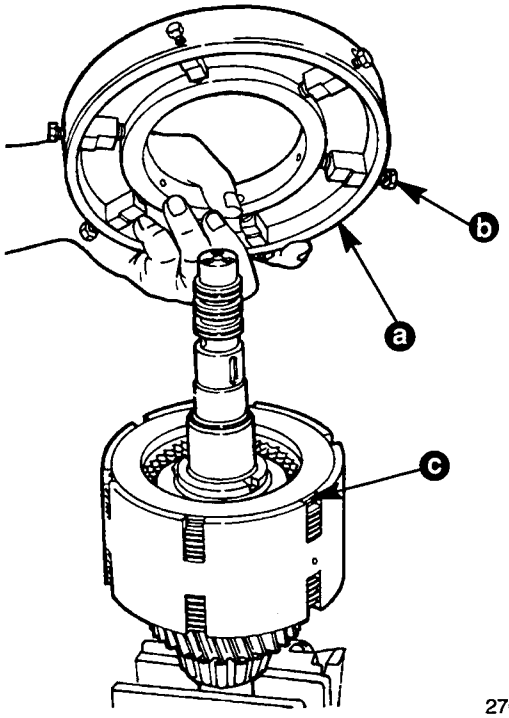
34. Position snap ring compression tool on clutch assembly so that compression screws are centered over slots in clutch housing.

35. Remove end disc and snap ring as follows:

    a. Tighten all compression screws until a slight resistance is felt.

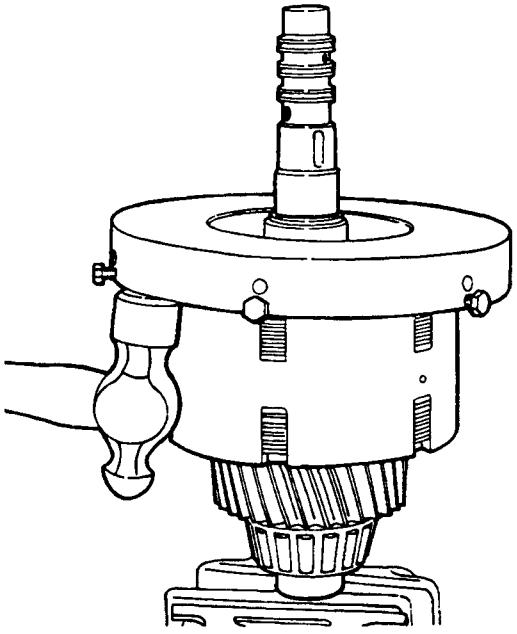
    b. Tighten compression screws evenly (approximately 1/2 turn at a time).

    c. Tap up lightly on bottom edge of compression tool until snap ring pops up and out of groove in clutch housing.



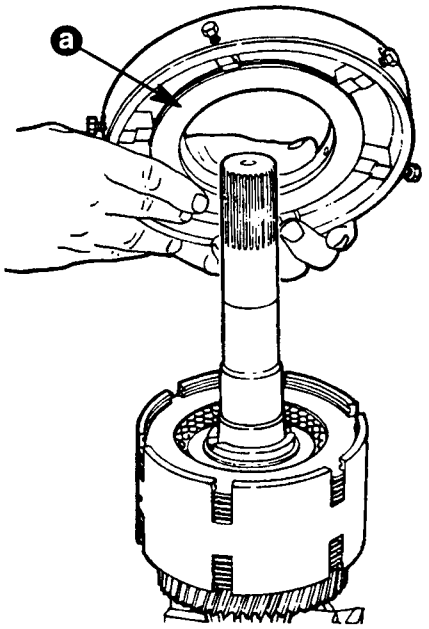
27674

a - Snap Ring Compression Tool
b - Compression Screws (6)
c - Slots



27675

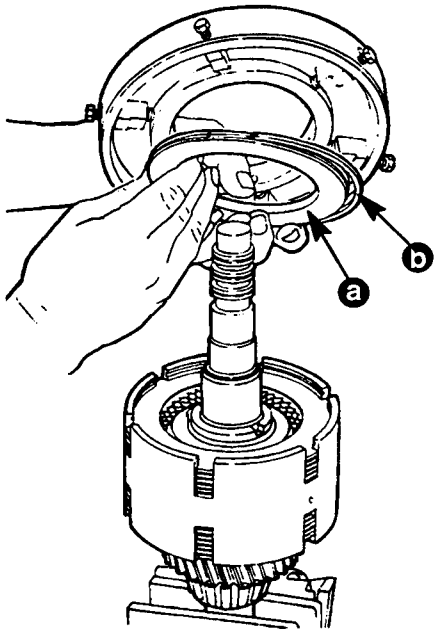
NOTE: For ease of reassembly, end disc and snap ring should not be removed from tool unless their condition is questionable.



27676

a - End Disc (Snap Ring Compressed)

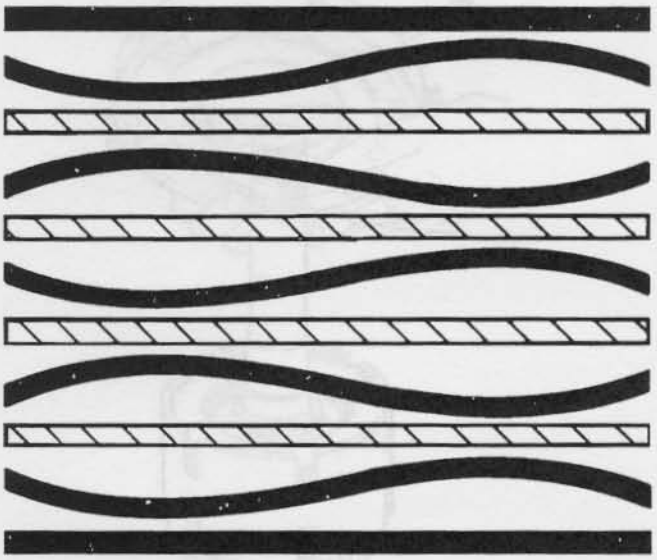
    d. If necessary, remove end disc and snap ring from tool.



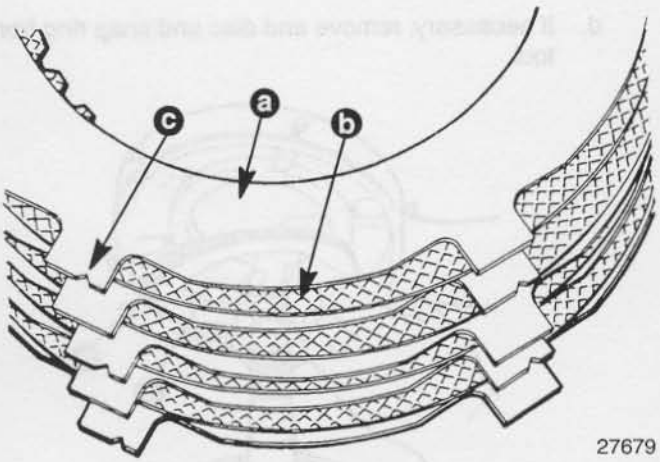
27676

a - End Disc
b - Snap Ring

IMPORTANT: Thrust discs have a wave pattern. These discs must be reinstalled in a specific pattern, when reassembled. Make note of notches in thrust disc tabs, and how they are arranged.



50248



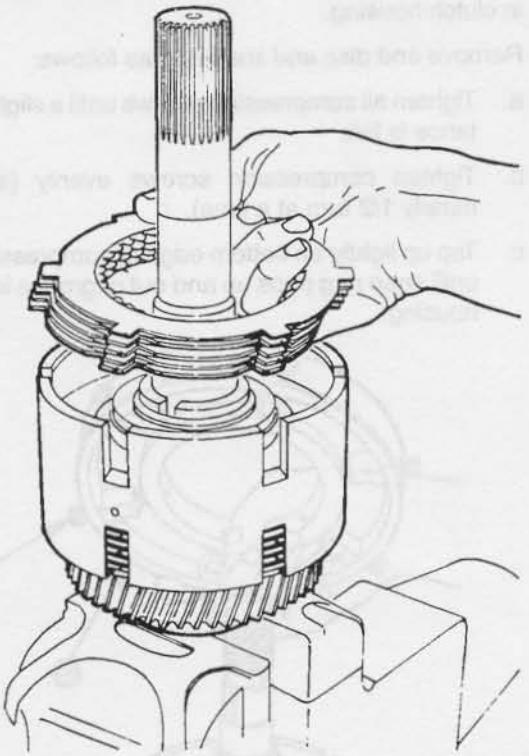
27679

a - Thrust Discs (5 per side) (See NOTE)
b - Inner Discs (4 per side) (See NOTE)
c - Notches

NOTE: 800 AM Transmissions have additional thrust discs (6 total per side) and inner discs (5 total per side).

630A Clutch Arrangement Shown (800AM Similar)

36. Remove discs.



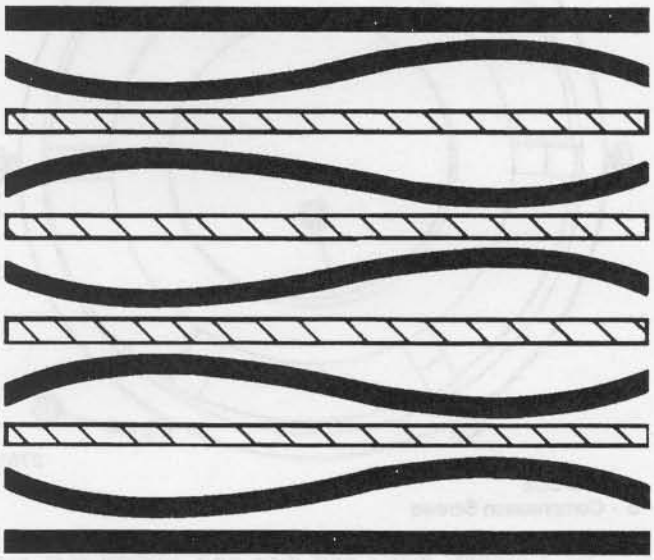
27680

37. Inspect thrust discs and inner discs for wear. Replace if there is any questionable wear.
38. Remove and inspect disc on opposite side of clutch in same manner.

Reassembly

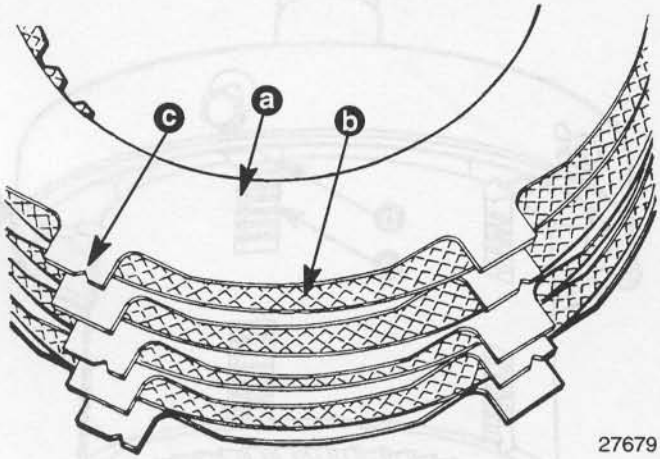
CLUTCH DISCS

IMPORTANT: Thrust discs have a wave pattern. These discs must be reinstalled in a specific manner as explained following.



50248

1. Arrange thrust discs and inner discs as shown. Ensure notches on thrust disc tabs are aligned as shown.



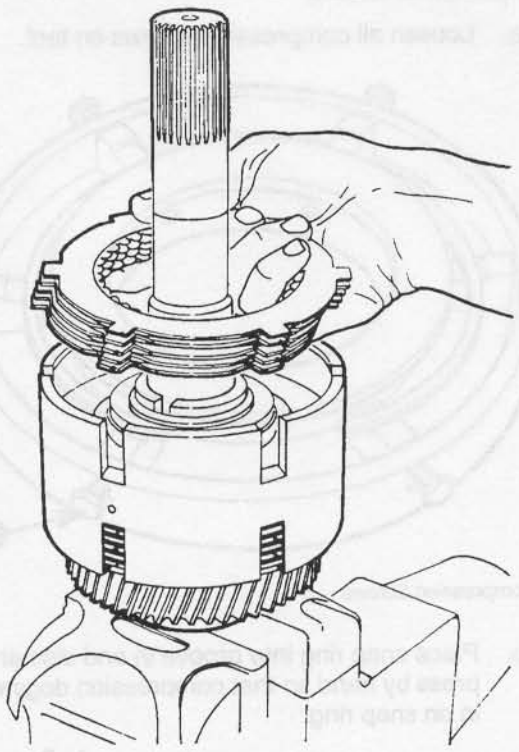
27679

a - Thrust Discs (5 per side) (See NOTE)
b - Inner Discs (4 per side) (See NOTE)
c - Notches

NOTE: 800 AM Transmissions have additional thrust discs (6 total per side) and inner discs (5 total per side).

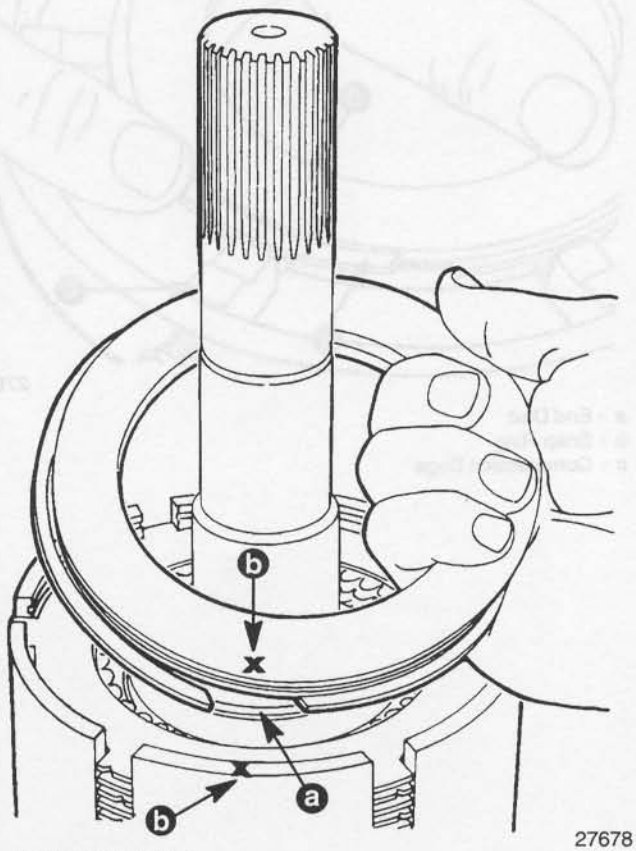
630A Clutch Arrangement Shown (800AM Similar)

2. Install discs in clutch housing.



27680

3. Align snap ring opening with reference marks on end disc and clutch housing.

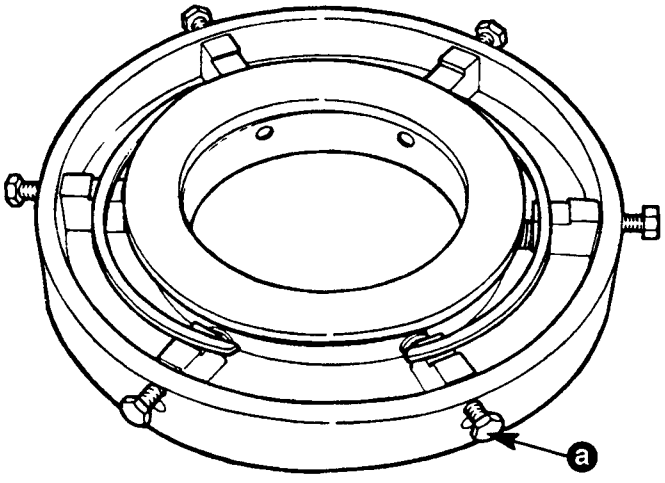


27678

a - Snap Ring Opening
b - Reference Marks

4. If end disc and snap ring were removed from tool, reinstall as follows:

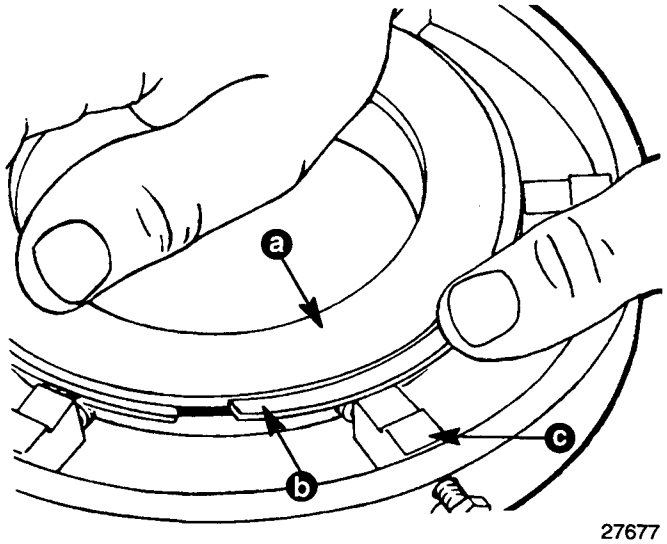
   a. Loosen all compression screws on tool.



27677

a - Compression Screws

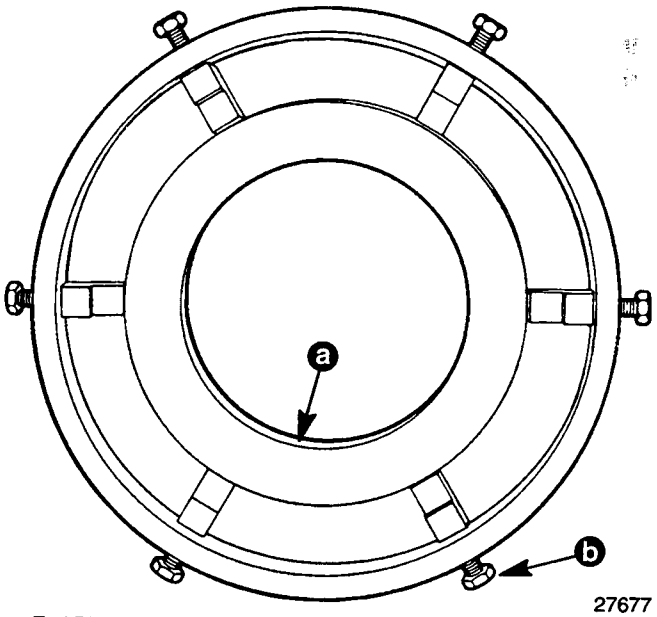
   b. Place snap ring into groove in end disc and compress by hand so that compression dogs will hold in on snap ring.



27677

a - End Disc
b - Snap Ring
c - Compression Dogs

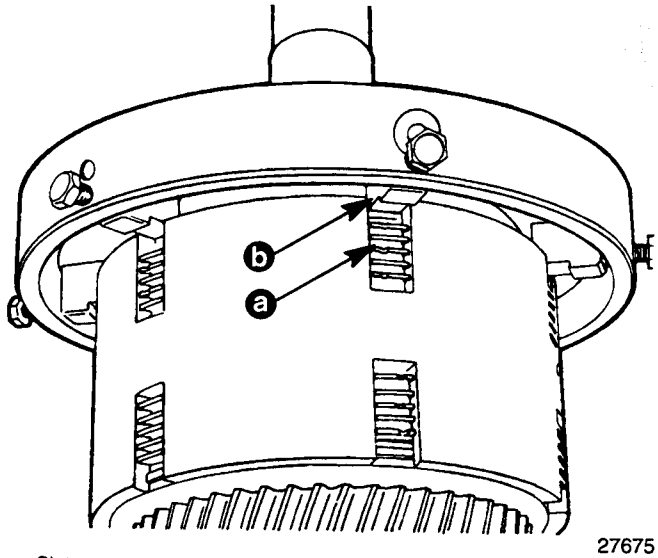
   c. Tighten compression screws evenly to completely compress snap ring into end disc.



27677

a - End Disc
b - Compression Screws

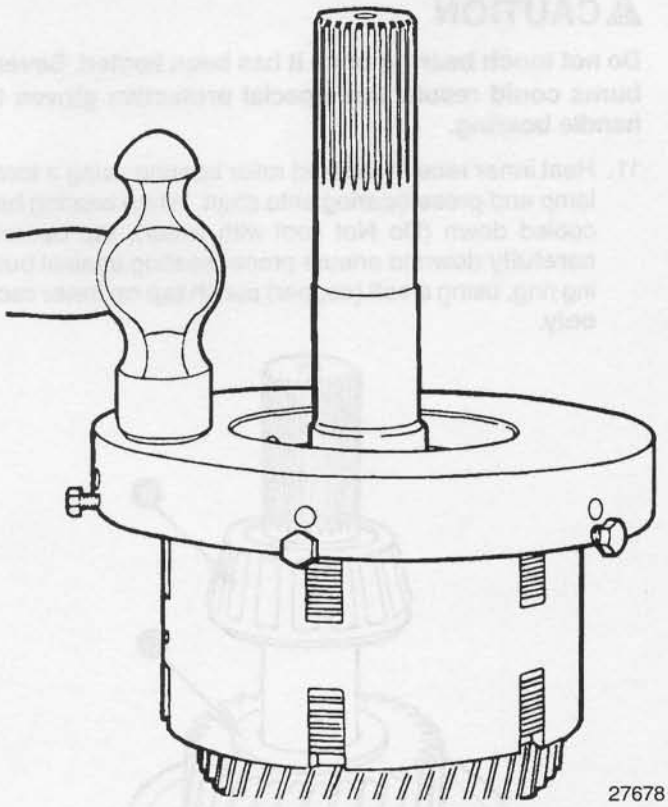
   d. Carefully lower end disc and special tool onto clutch housing and align compression dogs with slots in housing.

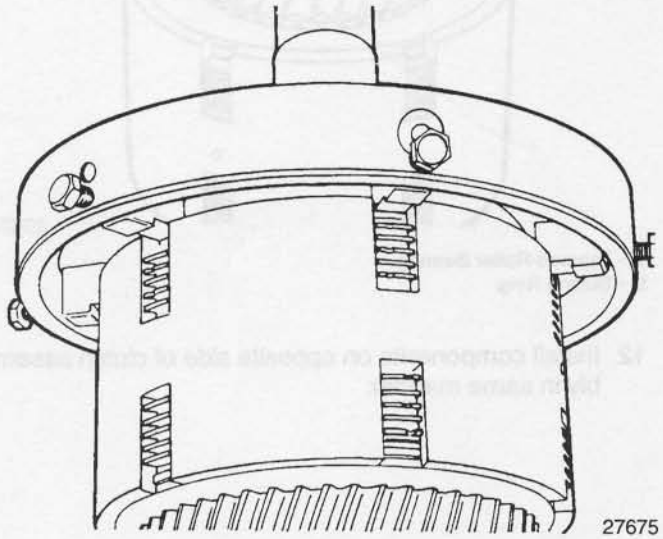


27675

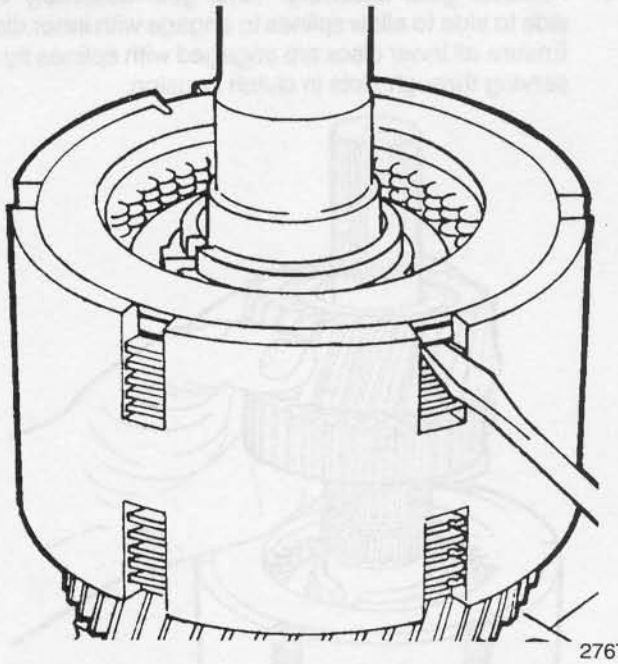
a - Slots
b - Compression Dogs

5. Tap lightly around top of tool until end disc bottoms. Loosen compression screws and remove tool.


27678


27675

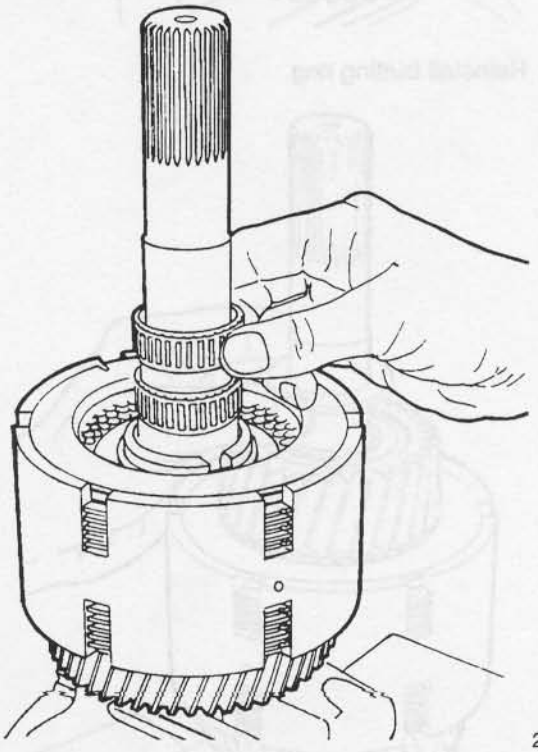
6. Double check that snap ring has been properly seated by prying up lightly on end disc.


27679

7. Reinstall discs on opposite side of clutch in same manner.

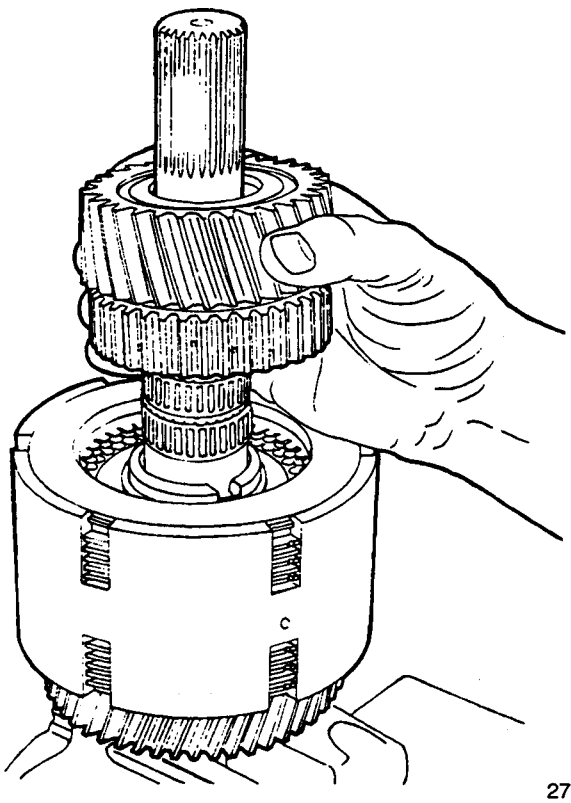
NEEDLE BEARINGS

8. Reinstall needle bearings.


27680

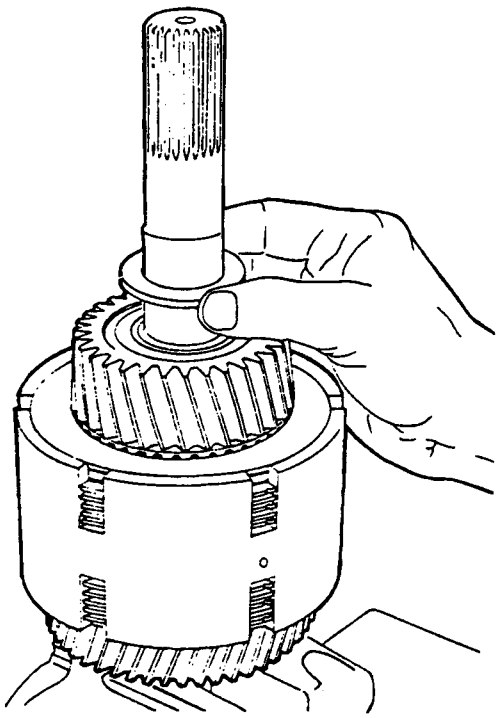
GEAR ASSEMBLY

9. Reinstall gear assembly. Twist gear assembly from side to side to allow splines to engage with inner discs. Ensure all inner discs are engaged with splines by observing through slots in clutch housing.



27673

10. Reinstall butting ring.



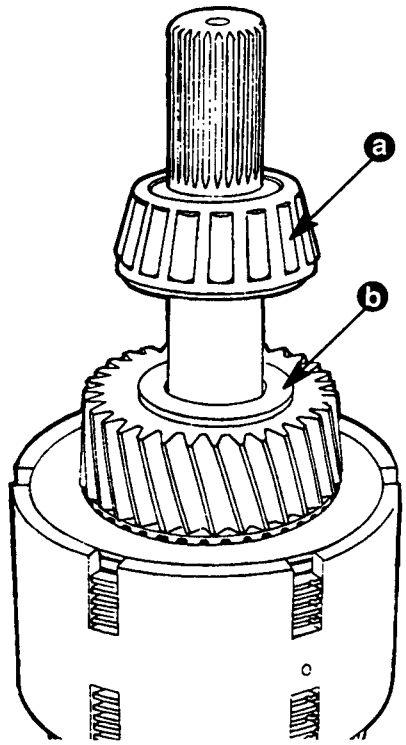
27672

TAPERED ROLLER BEARING

⚠CAUTION

Do not touch bearing once it has been heated. Severe burns could result. Use special protective gloves to handle bearing.

11. Heat inner race of tapered roller bearing using a torch lamp and press bearing onto shaft. When bearing has cooled down (Do Not cool with water), tap bearing **carefully** down to ensure proper seating against butting ring, using a soft (copper) punch **tap on inner race only.**



27674

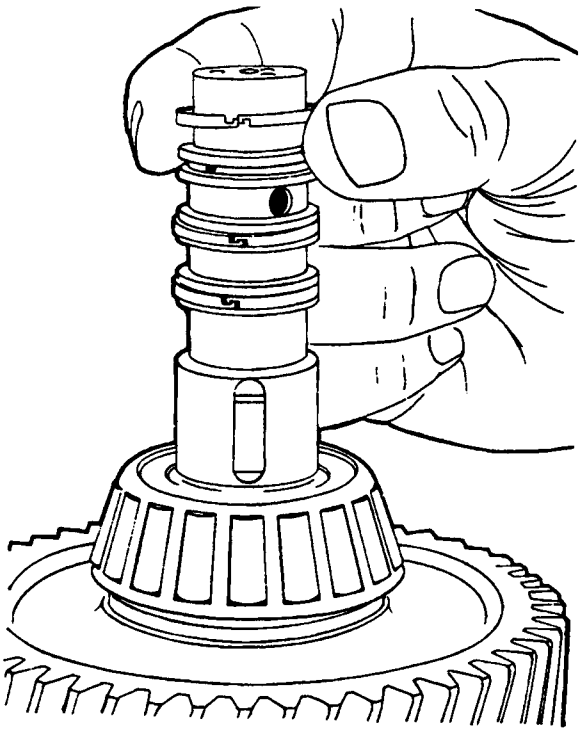
a - Tapered Roller Bearing
b - Butting Ring

12. Install components on opposite side of clutch assembly in same manner.

⚠CAUTION

Use care installing piston rings on input shaft. Piston rings are brittle and may snap if spread too far open.

13. Install piston rings on input shaft. Ensure ends of rings are coupled as shown. Then, position rings so that ends are staggered so no two are aligned.



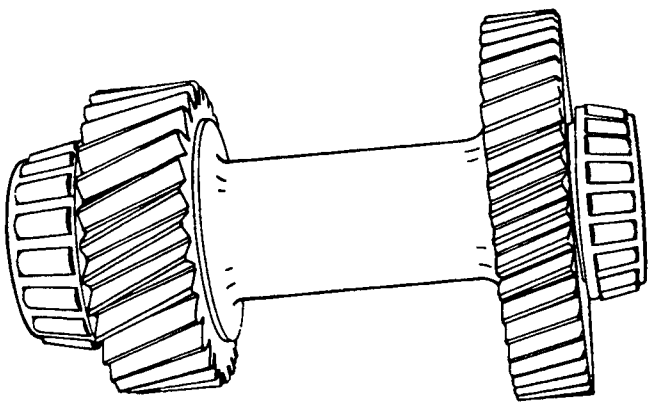
27679

INTERMEDIATE SHAFT

⚠WARNING

Do not touch bearing once it has been heated. Severe burns could result. Use special protective gloves to handle bearing.

14. Heat inner race of tapered roller bearing using a torch lamp and press bearing onto shaft. When bearing has cooled down (Do Not cool with water), tap bearing **carefully** down to ensure proper seating against gear, using a soft (copper) punch. **Tap on inner race only.**



71045

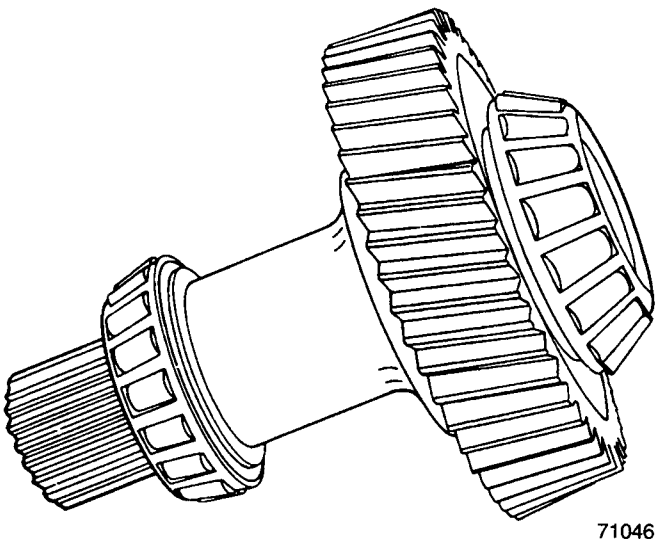
15. Install tapered roller bearing on opposite end of shaft in the same manner.

OUTPUT SHAFT

⚠WARNING

Do not touch bearing once it has been heated. Severe burns could result. Use special protective gloves to handle bearing.

16. Heat inner race of tapered roller bearing using a torch lamp and press bearing onto shaft. When bearing has cooled (Do Not cool with water), drive bearing down against gear using a soft (copper) punch, tapping on inner race only.



71046

17. Install tapered roller bearing on opposite end of shaft in the same manner.

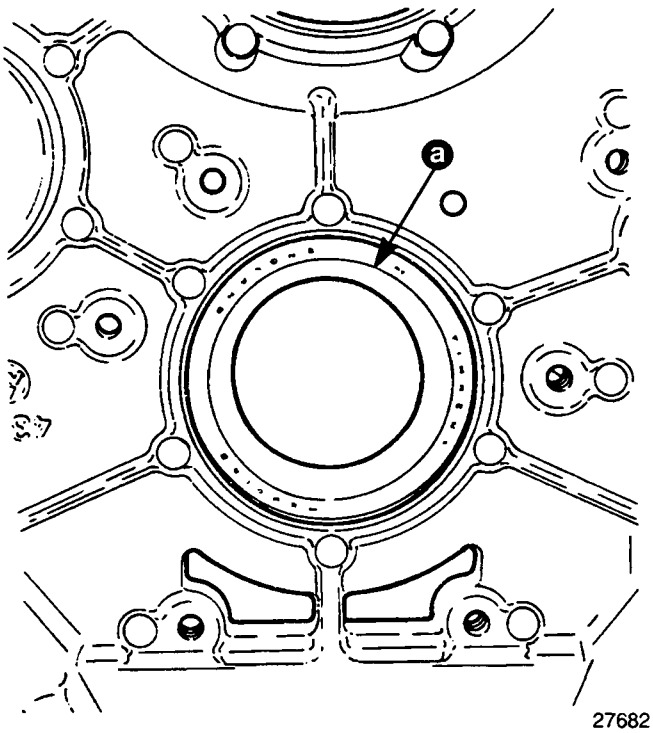
NOTE: Bearing on splined end of shaft is tapped until seated against shoulder on shaft.

Preassembly of Output Half of Housing

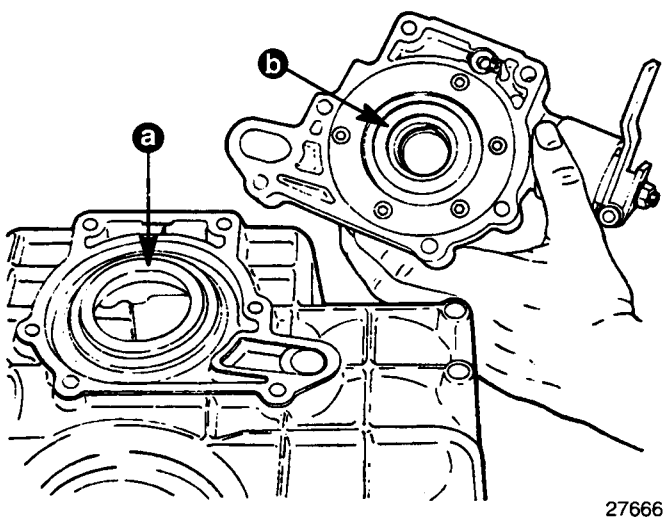
IMPORTANT: If tapered roller bearing cups were removed, ensure output shaft seal IS NOT in place, as it will be necessary to heat housing prior to installing bearing cups.

IMPORTANT: The tapered roller bearing cup on the input shaft (control block end) is properly positioned by bottoming out on the face of the control block assembly. It will be necessary to temporarily install control block to install this tapered roller bearing cup.

18. Temporarily install control block on outer housing. Tighten bolts securely.



27682



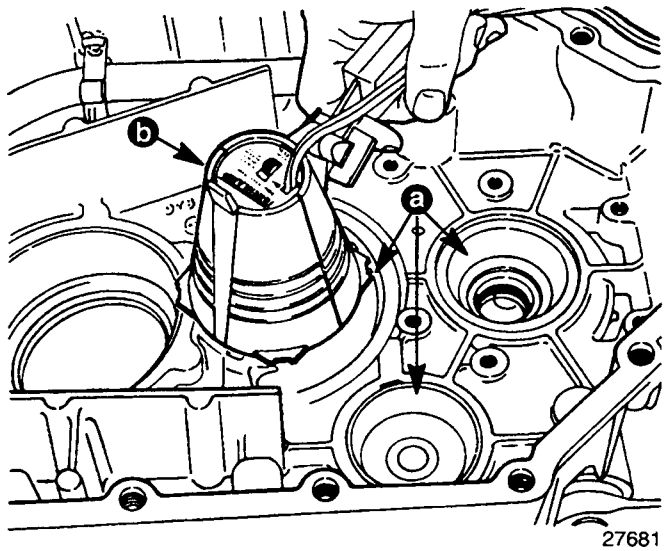
27666

a - Input Shaft Bearing Cup
b - Control Block Face

⚠ WARNING

Use care in handling housing, once it is heated with torch lamp. Severe burns could result. Use special protective gloves when handling housing.

19. Heat bearing bores of housing using a torch lamp and install bearing cups using a suitable mandrel.



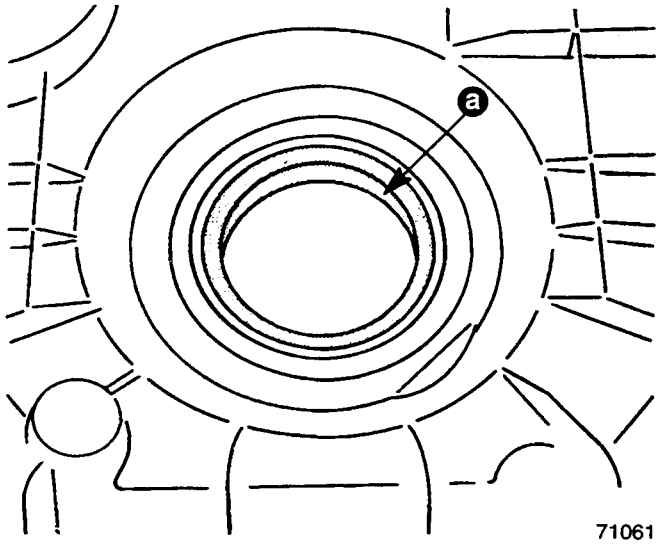
27681

a - Bearing Cups
b - Torch Lamp

20. Allow housing to cool (Do Not cool with water) and then tap bearing cup with suitable mandrel to ensure it is properly seated.
21. Remove control block assembly.

OUTPUT SHAFT SEAL

22. **If bearings were not replaced and no shimming is required,** push new seal onto special mandrel. Ensure seal will be positioned with lip of seal facing inward. Drive seal uniformly into bore of housing to the point that it is countersunk .040 in. (1mm) with reference to housing surface.

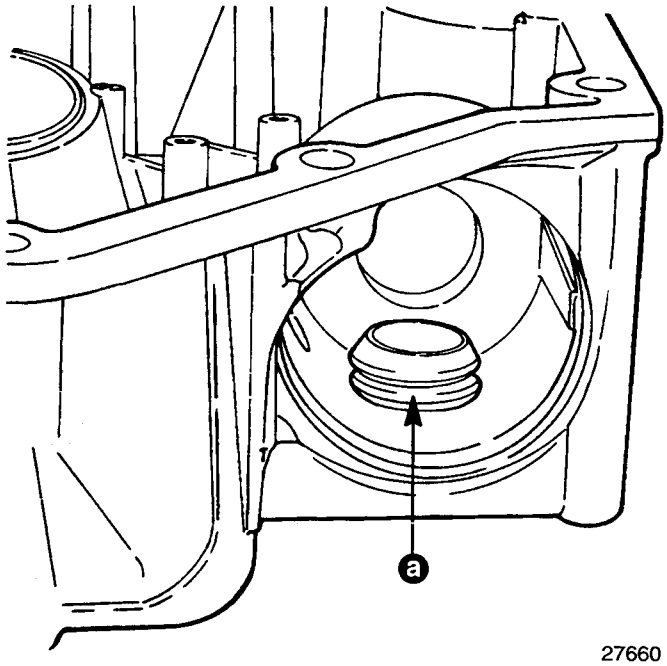


71061

a - Seal

SUCTION PIPE

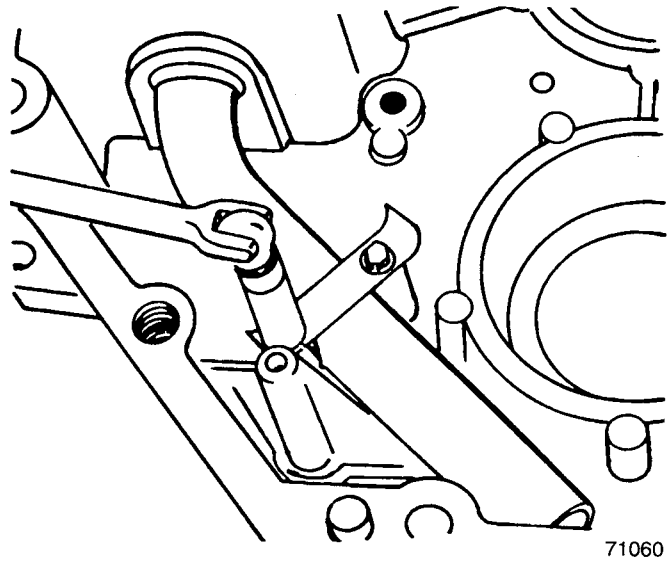
23. Reinstall suction pipe seal in bottom of oil filter bore. Coat seal with ATF.



27660

a - Seal

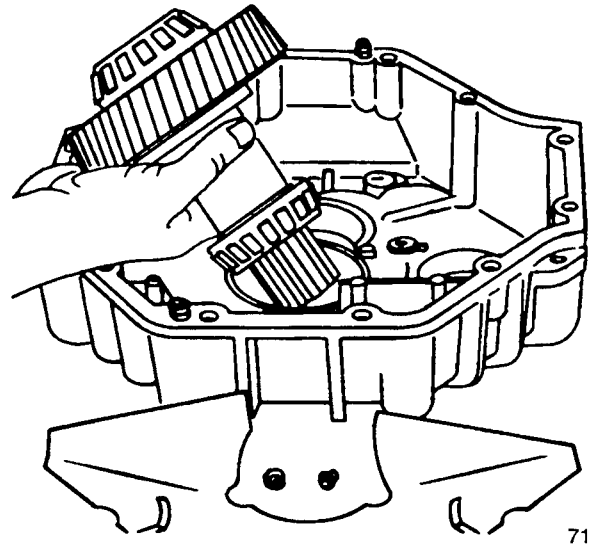
24. Reinstall suction pipe. Place one drop of Loctite Type "A" on screw threads. Then, secure suction pipe down with retainer plate. Tighten screws securely.
25. Bend tabs down over screws.



71060

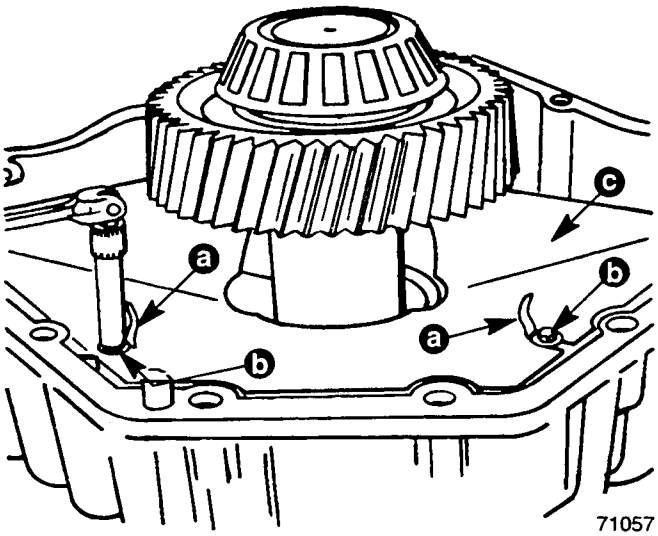
SHAFTS and BAFFLE PLATE

26. Coat tapered roller bearings with ATF.
27. Install output shaft.



71058

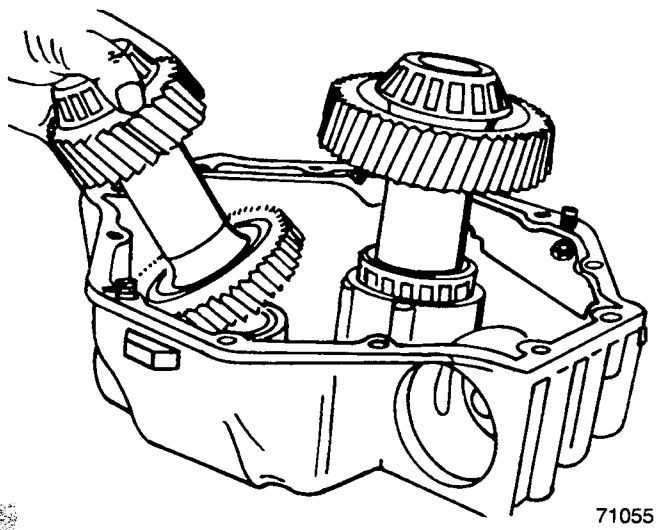
28. Install baffle plate. Apply one drop of Loctite Type "A" to screws. Tighten screws securely and bend tabs down over screws.



71057

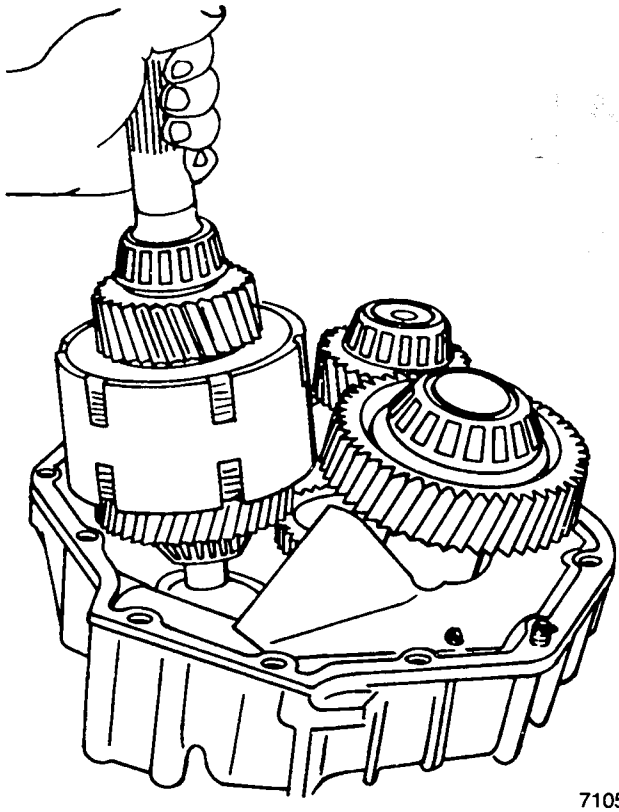
a - Tabs
b - Screws
c - Baffle Plate

29. Install intermediate shaft.

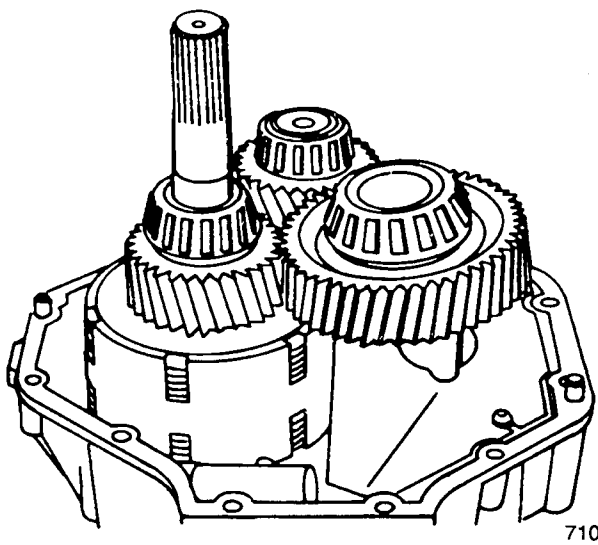


71055

30. Install input shaft. Ensure all gears mesh as shown.



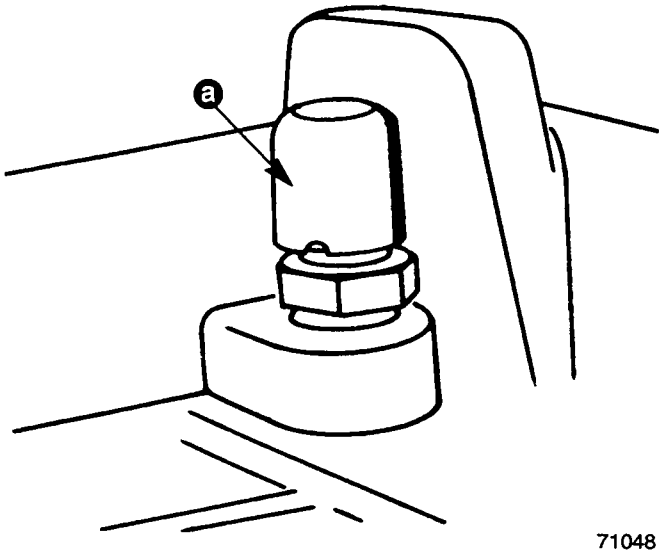
71054



71062

Preassembly of Input Half of Housing

31. Install breather valve (do not overtighten).



71048

a - Breather Valve

BEARING PRELOAD ADJUSTMENT

IMPORTANT: If new tapered roller bearings have been installed, the preload must be readjusted. If bearing were not replaced, proceed to the final reassembly section.

NOTE: The required preload of bearings of the individual shafts is obtained by using shims beneath the tapered roller bearing cups in the input half of the housing.

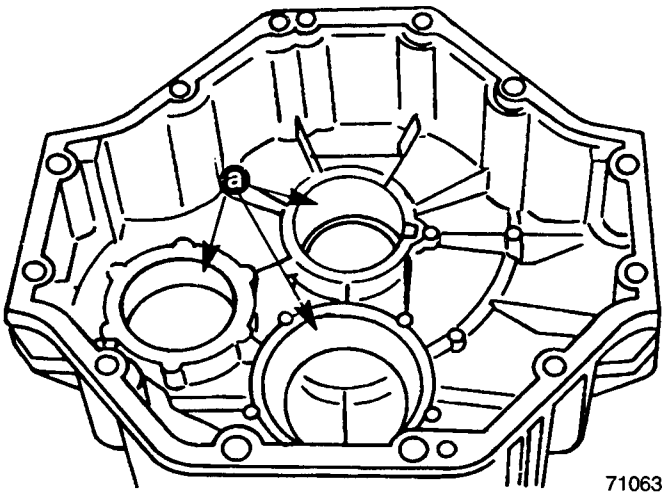
NOTE: Shims which have been removed during disassembly may be reused.

32. Subtract approximately .008 in. (0.2mm) of shims from each bearing cup bore. Remove and set aside, but do not mix up.

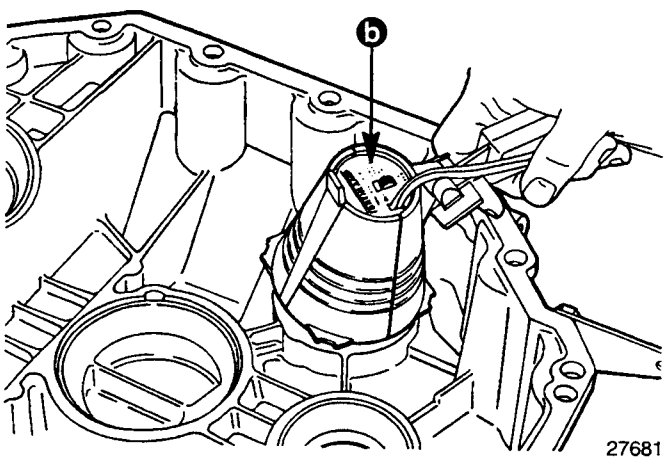
⚠ WARNING

Use care in handling housing once it has been heated with a torch lamp. Severe burns could result. Use special protective gloves when handling housing.

33. Heat each tapered roller bearing cup bore with a torch lamp. Insert shims (less those removed) and bearing cups into appropriate bearing bores. When housing has cooled (Do Not cool with water), tap bearing cups with a suitable mandrel to ensure that cups are fully seated.



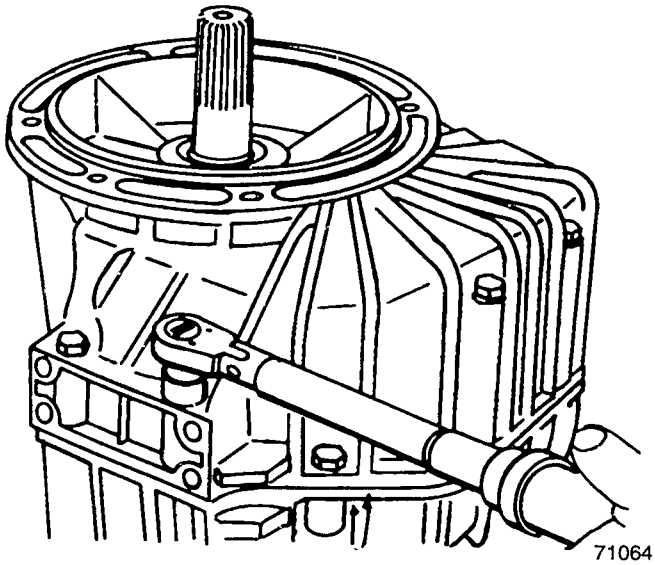
71063



27681

a - Bearing Cups
b - Torch Lamp

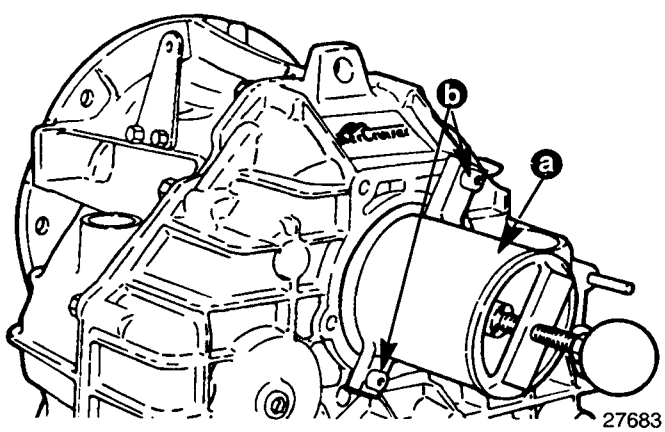
34. Install input half of housing onto output half. Ensure locator pins are in place. Install bolts and lockwashers and torque to 36 lb. ft. (49 N·m).



INPUT SHAFT PRELOAD

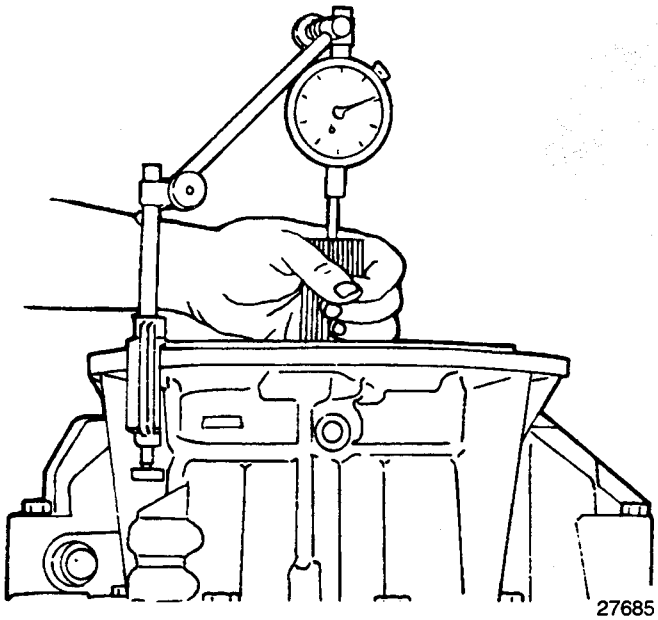
35. Measure bearing clearance as follows:

    a. Install special tool as shown. Tighten hold down bolts securely.

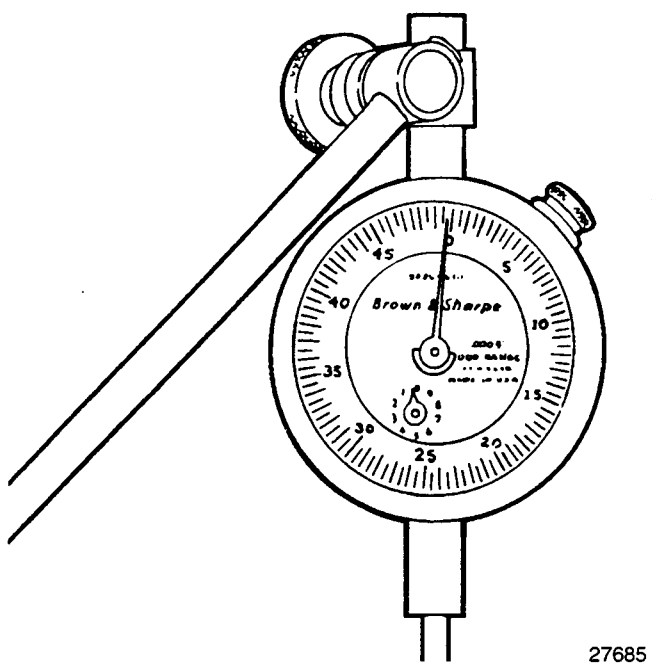


a - Special Tool
b - Hold Down Bolts

    b. Mount dial indicator on input shaft. Turn input shaft several times to seat bearing.

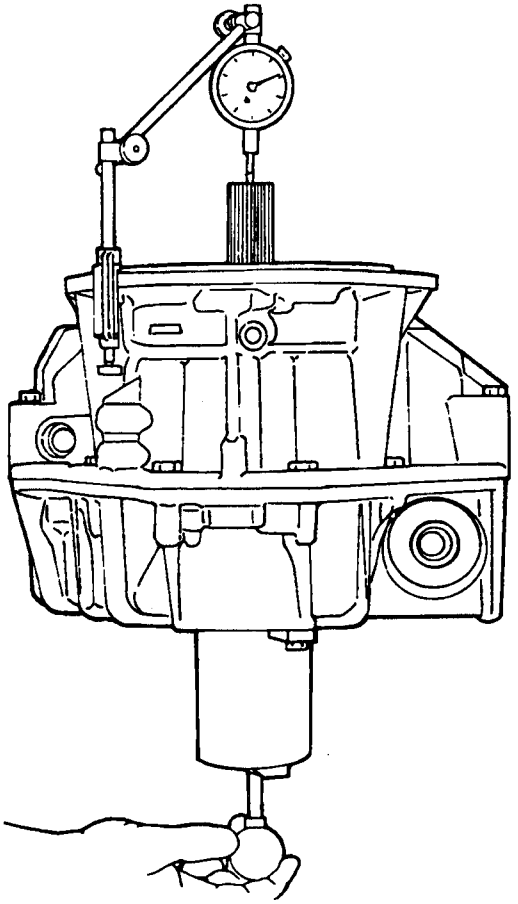


    c. Zero the dial indicator.



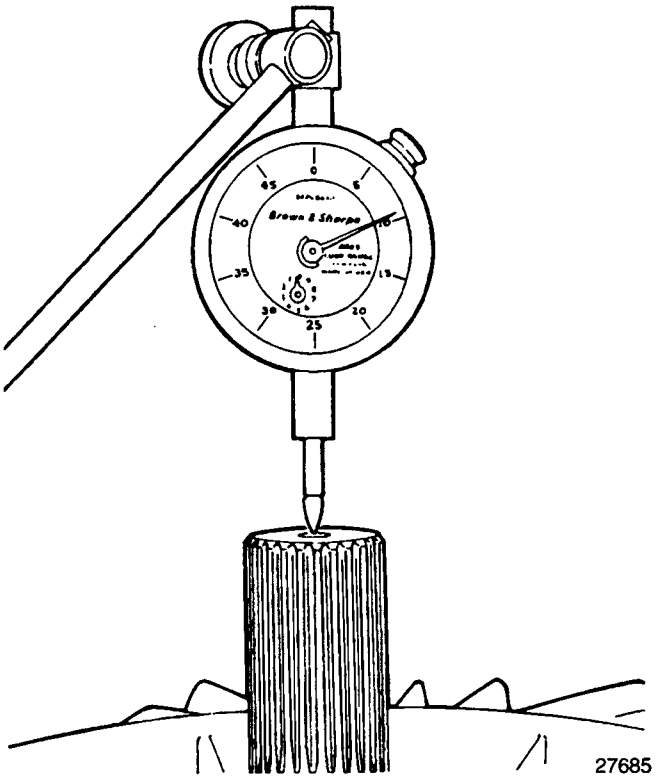
IMPORTANT: The following step should be done very carefully to obtain the actual bearing clearance. Avoid bumping the input shaft and turn very slowly on the special tool knob. (Shaft will only be moving a very small amount.)

d. Slowly turn the special tool knob clockwise to push the shaft upward. (Perform the above sequence several times to ensure on accurate reading.)



27682

e. Make note of reading. The bearing clearance measured **PLUS** the preload required is equal to the amount of shim thickness to be **ADDED.**



27685

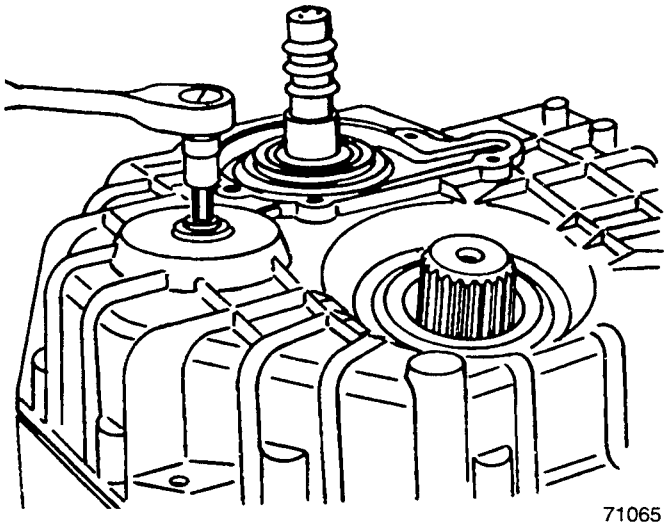
Example:

	Bearing Clearances Measured	.009 in.
+	Bearing Preload Required	.004 in.
=	Shims to Be Added	.013 in.

INTERMEDIATE SHAFT PRELOAD

36. Measure bearing clearance as follows:

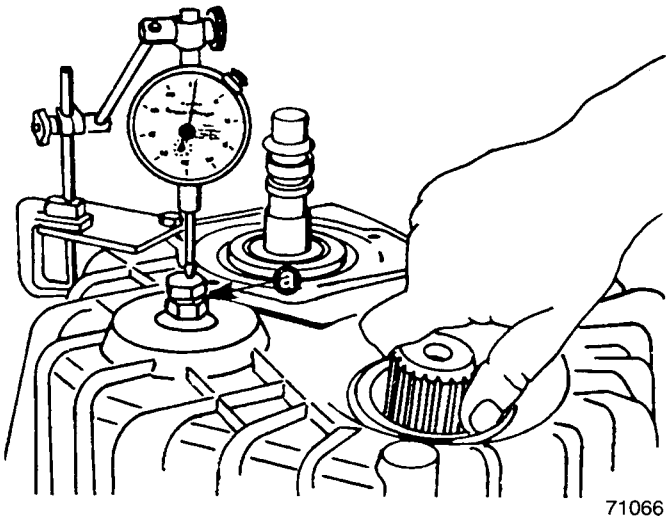
    a. Remove hex plug from housing.



71065

    b. Screw special bolt with nut into intermediate shaft and tighten snuggly. Turn nut up until it touches bolt head.

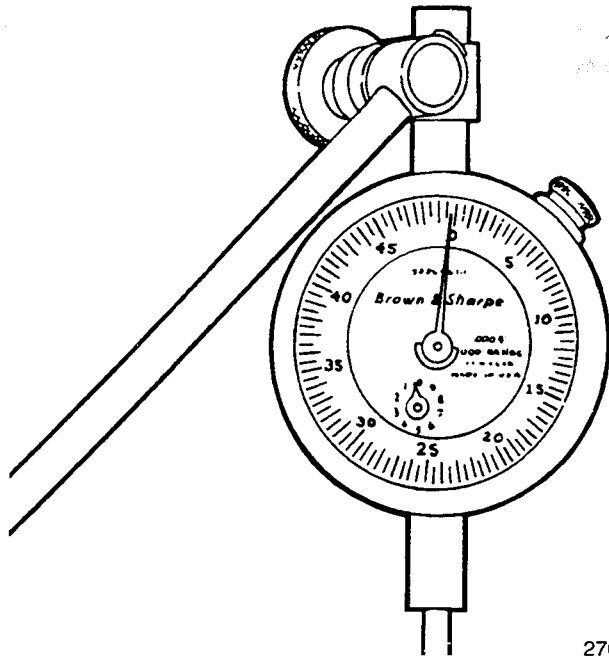
    c. Mount dial indicator on bolt head. Turn output shaft several times to ensure bearing is seated.



71066

a - Special Bolt with Nut

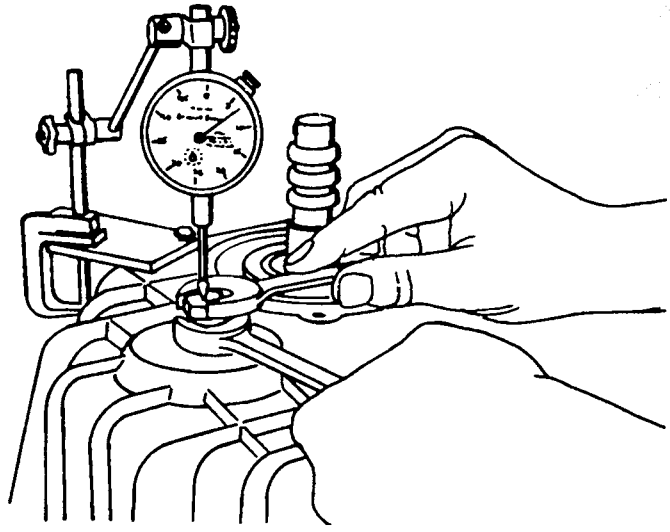
    d. Zero dial indicator.



27685

IMPORTANT: The following step should be done very carefully, to obtain the actual bearing clearance. Turn nut very slowly as shaft will only be moving a small amount.

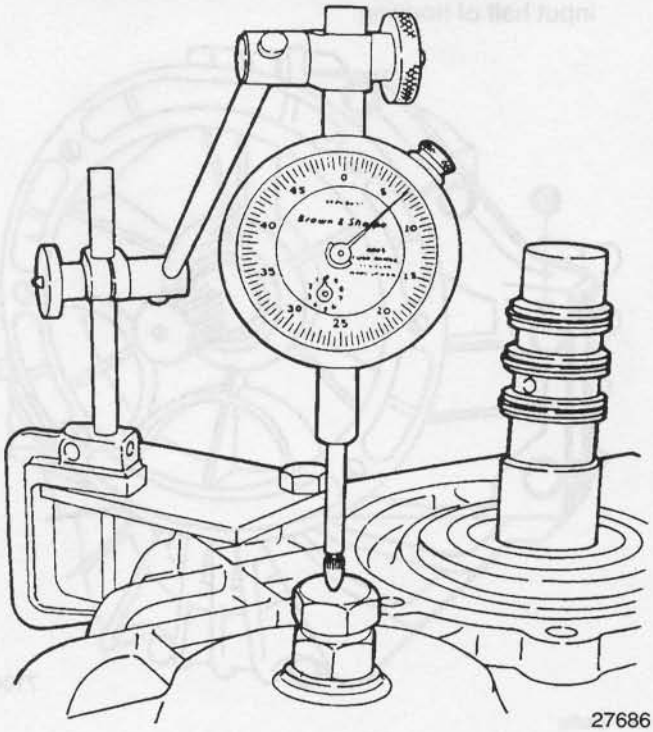
    e. Hold bolt with one wrench and slowly turn down nut to pull shaft upward. (Perform the above sequence several times to ensure accurate reading.)



71067

a - Bolt - Hold Stationary
b - Nut - Turn to Move Shaft

f. Make note of the reading. The bearing clearance measured **PLUS** the preload required is equal to the amount of shim thickness to be **ADDED.**



27686

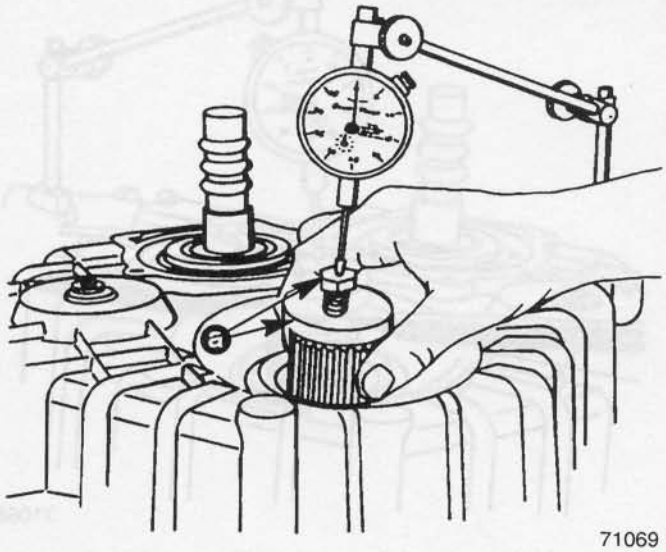
Example:

	Bearing Clearance Measured	.007 in.
+	Bearing Preload Required	.004 in.
=	Shims to Be Added	.011 in.

g. Remove dial indicator, special bolt and nut, and re-install hex plug. Tighten securely.

OUTPUT SHAFT PRELOAD

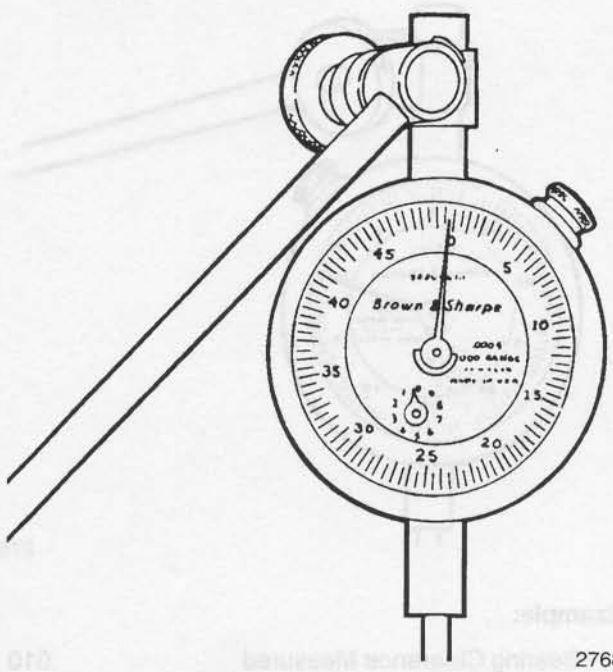
37. Measure the bearing clearance as follows:
    a. Install flange washer and bolt. Tighten snuggly.
    b. Mount dial indicator on bolt head. Turn output shaft several times to ensure bearing is seated.



71069

a - Flange Washer and Bolt

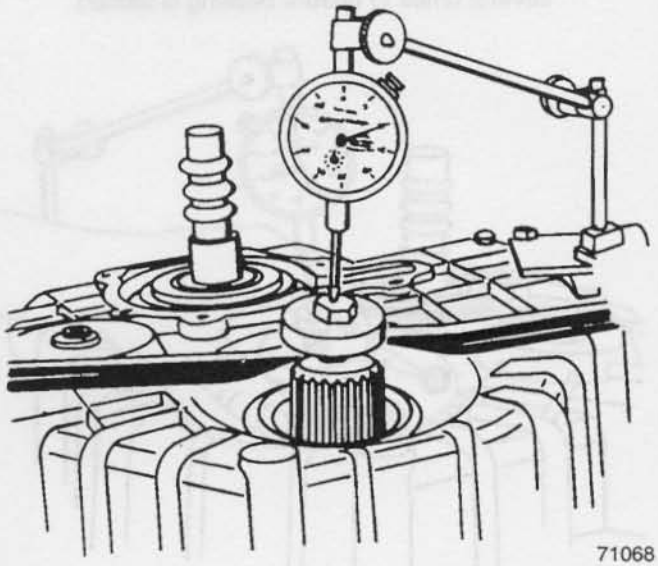
c. Zero dial indicator.



27685

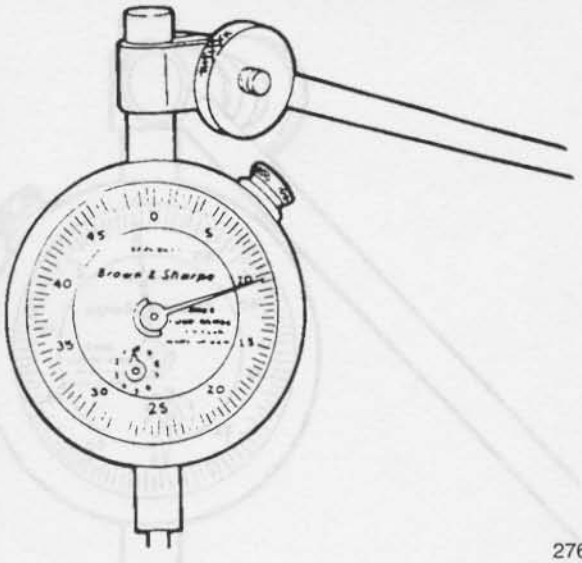
IMPORTANT: The following step should be done very carefully to obtain the actual bearing clearance. Pry up gently and evenly to lift shaft. Shaft will only move a small amount.

d. Pry up on washer to lift output shaft.



71068

e. Make note of the reading. The bearing clearance measured **PLUS** the preload required is equal to the amount of shim thickness to be **ADDED.**



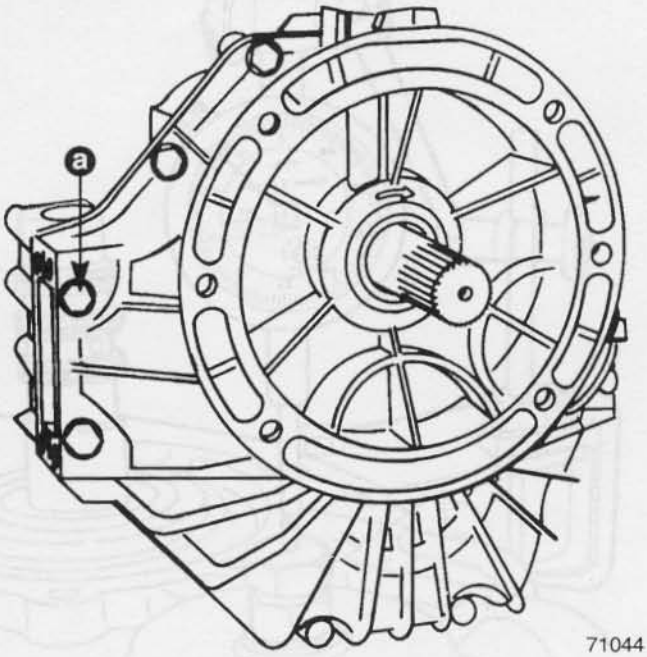
27686

Example:

	Bearing Clearance Measured	.010 in.
+	Bearing Preload Required	.004 in.
=	Shims to Be Added	.014 in.

f. Remove dial indicator. Remove bolt and flange washer.

38. When thickness of shims to be **ADDED** has been determined, the input half of housing must again be removed. Remove bolts and lockwashers, then lift off input half of housing.

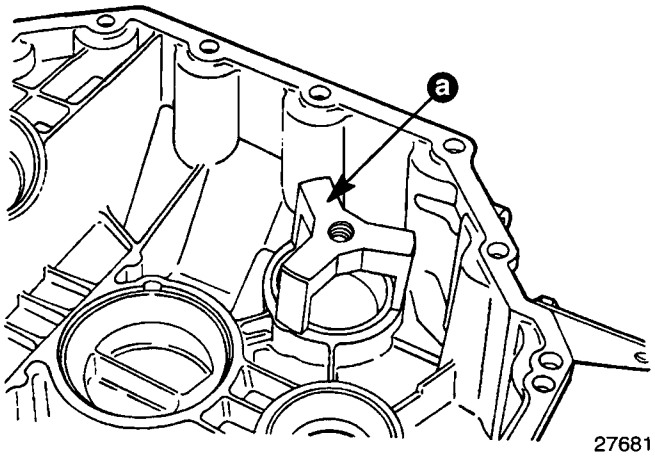


71044

a - Bolts

39. Remove tapered roller bearing cups from housing using special puller as follows:

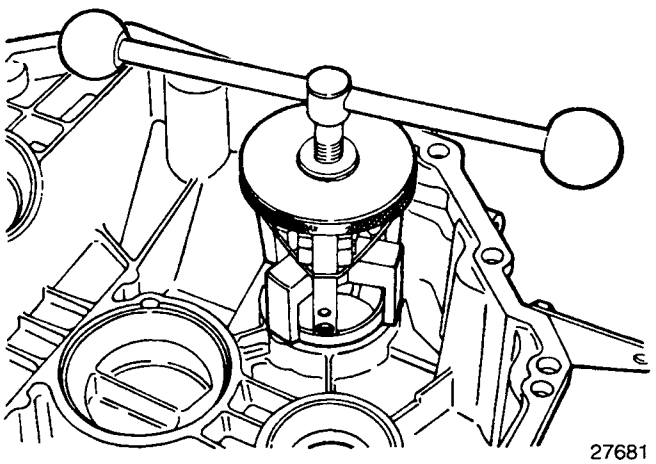
    a. Position appropriate puller guide (large or small diameter) over cup as shown.



27681

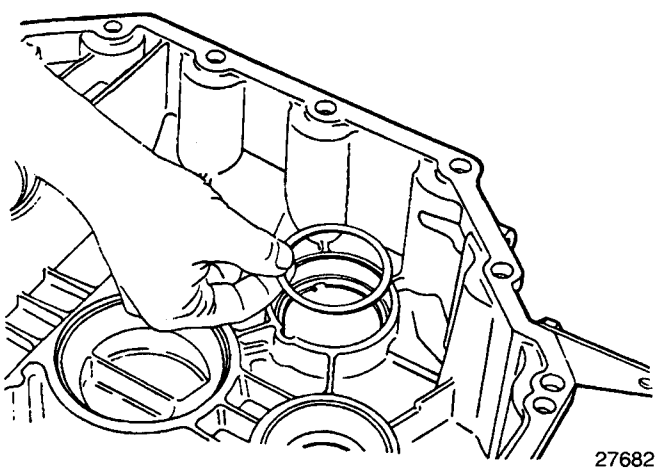
a - Small Diameter Puller Guide

    b. Pull bearing cup from housing as shown.



27681

40. Add the necessary amount of shims as determined previously to the appropriate bearing bores.

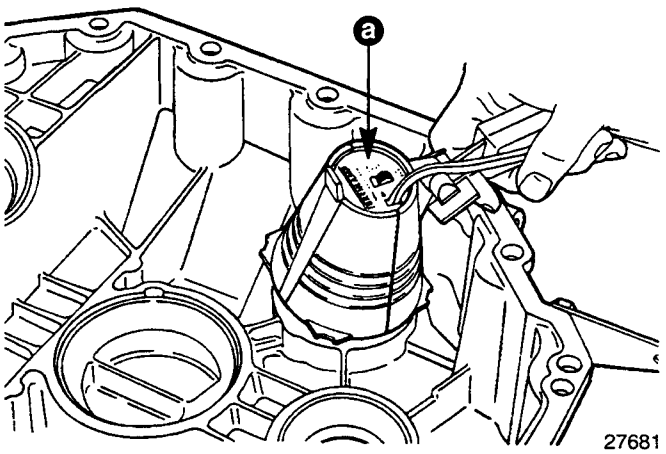


27682

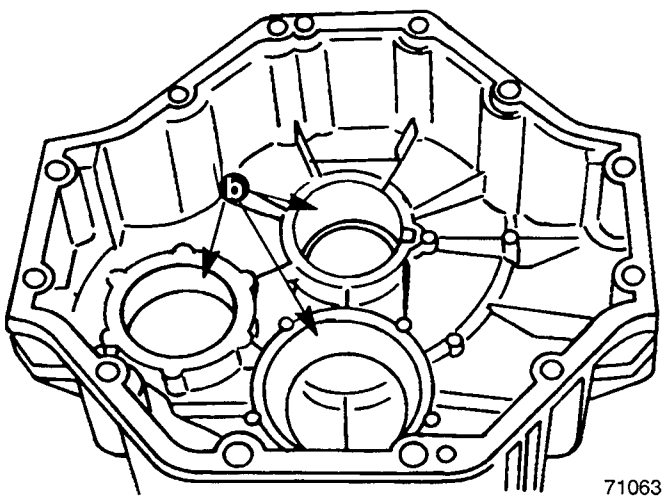
⚠ WARNING

Use care in handling housing once it has been heated with a torch lamp. Severe burns could result. Use special protective gloves when handling housing.

41. Heat each tapered roller bearing cup bore with a torch lamp. Install bearing cups into appropriate bore and tap into place using a suitable mandrel. When housing has cooled (Do Not cool with water), tap bearing cups to ensure they are fully seated.



27681



71063

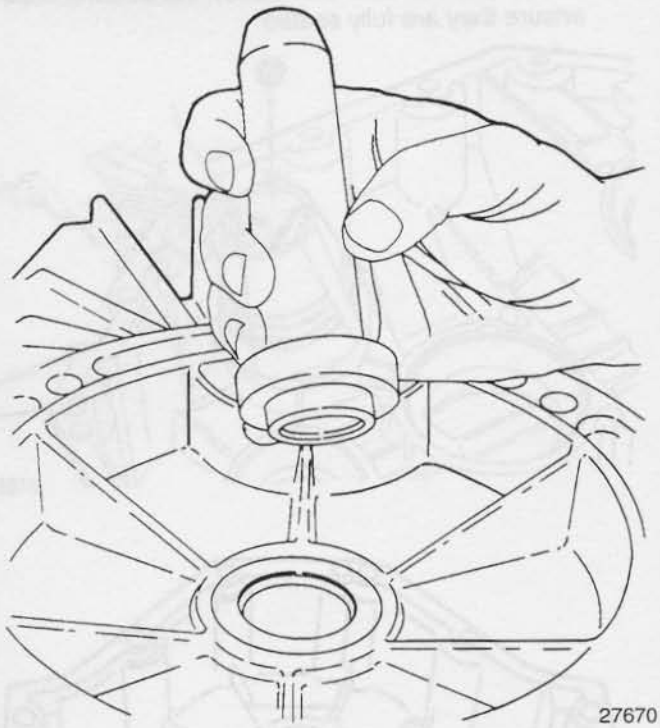
a - Torch Lamp
b - Bearing Cups

Final Assembly

INPUT SHAFT SEAL

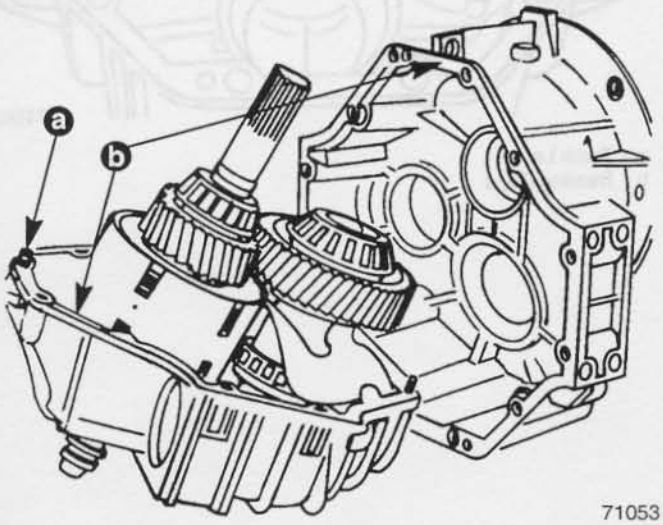
1. Push new seal onto special mandrel. Ensure seal will be positioned with lip of seal facing inward.

   Drive seal uniformly into bore of housing to the point that it is countersunk .040 in. (1mm) with reference to housing surface.



27670

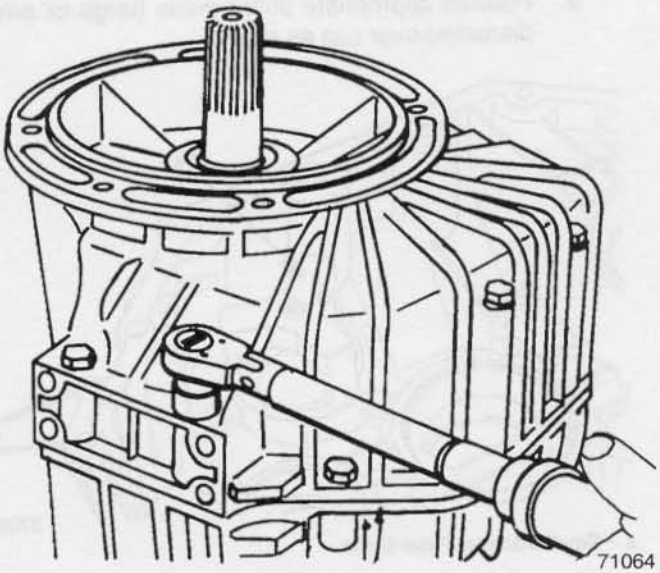
2. Coat lips of seals on input and output shafts with ATF.
3. Apply a thin layer of Loctite 515 Sealer to machined surfaces on housing halves. Reinstall input half of housing. Ensure locator pins are properly positioned.



71053

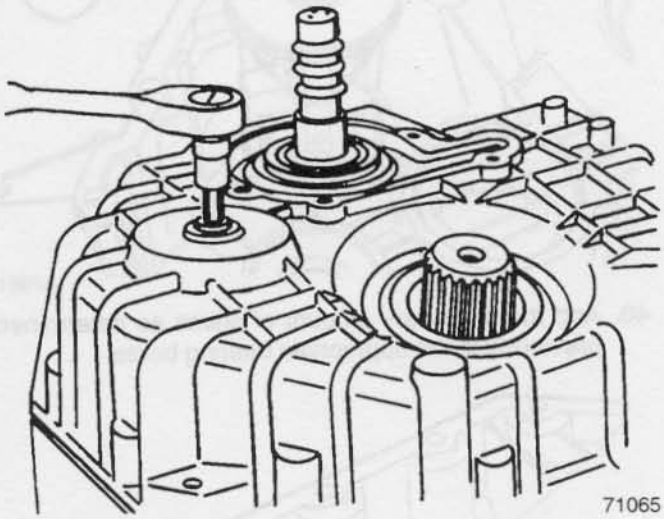
a - Locator Pins
b - Machined Surface

4. Install bolts and lockwashers and torque to 36 lb. ft. (49 N·m).



71064

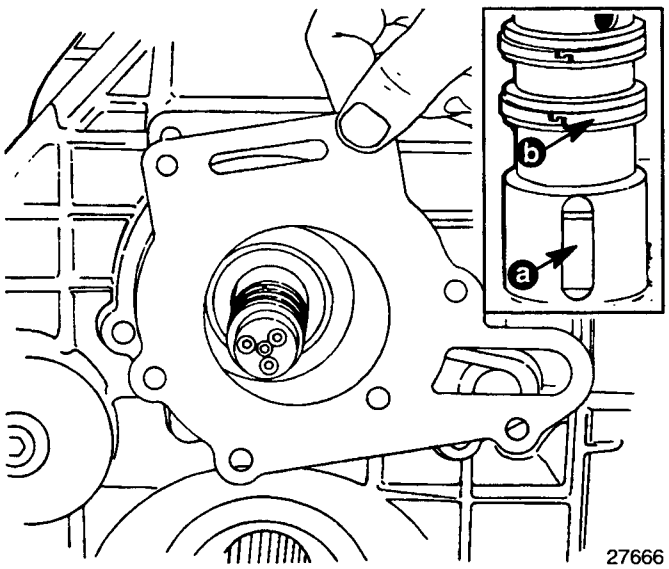
5. Double check to ensure that there is no shaft clearance on all three shafts. Refer back to previous steps if necessary, and use dial indicator.
6. Remove intermediate shaft hex plugs. Apply a drop of Loctite Type "A" to threads and reinstall in housing. Tighten securely.



71065

CONTROL BLOCK

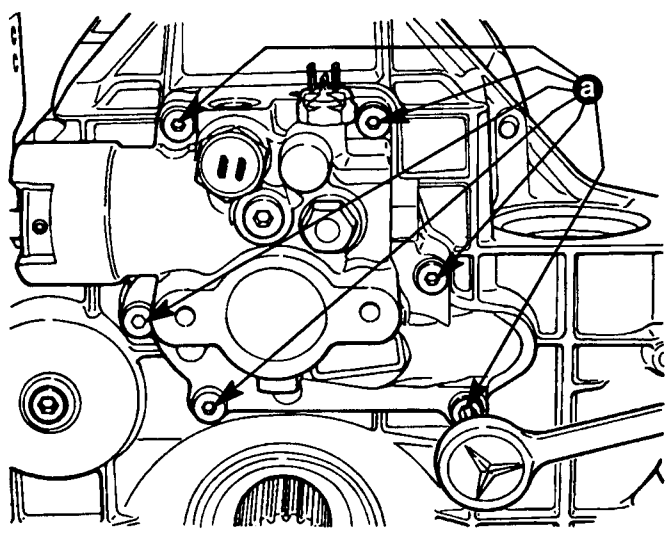
7. Ensure piston rings are in place and the key is in keyway. Align key on shaft with keyway in control block.
8. Install new gasket between control block and housing.



27666

a - Key
b - Piston Rings

9. Carefully push control block onto input shaft.
10. Coat each hex socket head bolt with a drop of Loctite Type "A." Secure control block to housing with bolts and lockwashers. Torque to 18 lb. ft. (25 N·m).

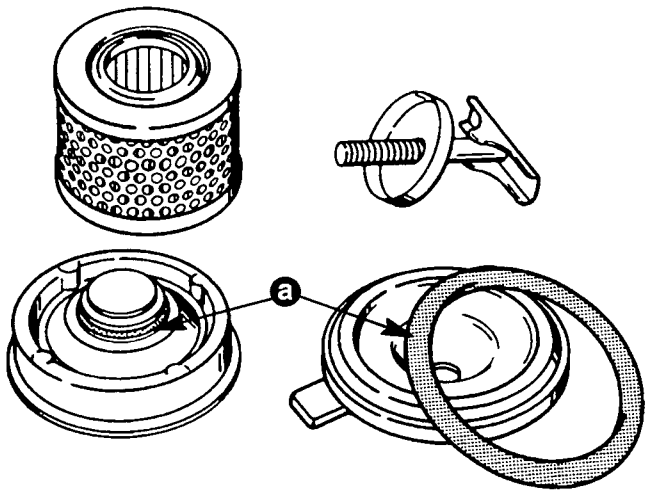


27661

a - Hex Socket Head Bolts (6)

FLUID FILTER

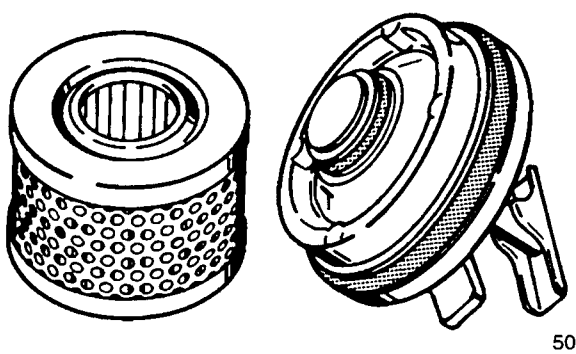
11. Coat new O-rings with ATF.



50975

a - O-rings

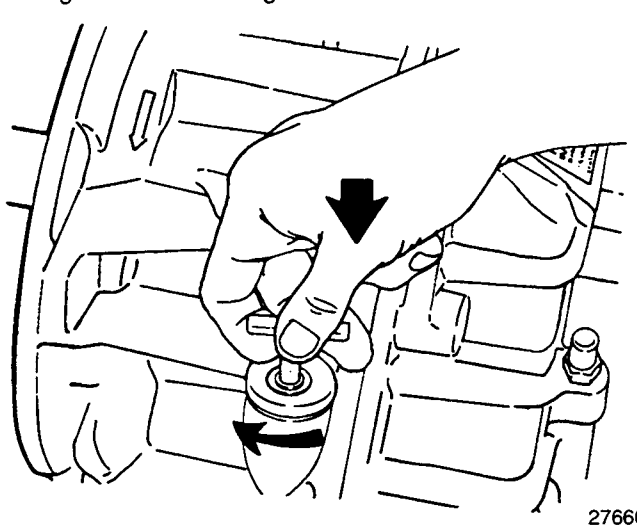
12. Reassemble filter assembly as shown. DO NOT tighten and compress upper O-ring.



50975

DIPSTICK

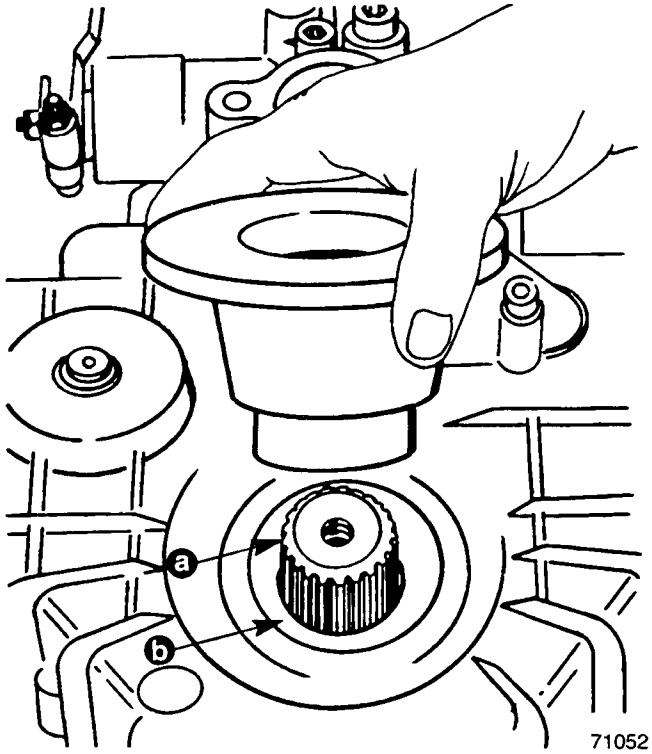
13. Coat sealing ring on dipstick with ATF.
14. Install dipstick into transmission and tighten by pressing down and turning clockwise at the same time.



27660

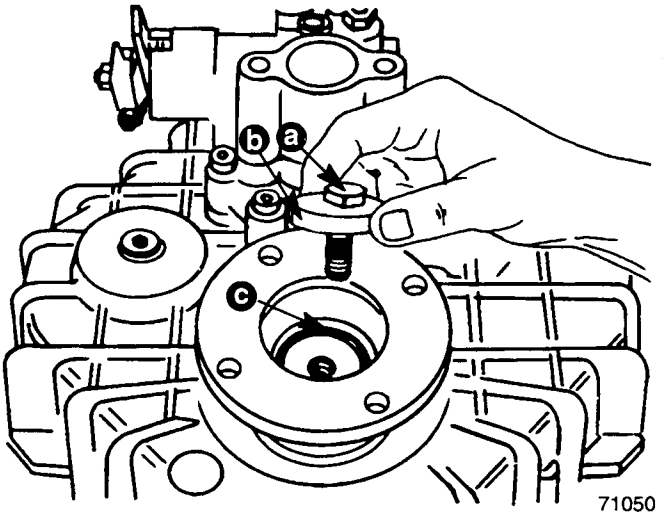
OUTPUT FLANGE

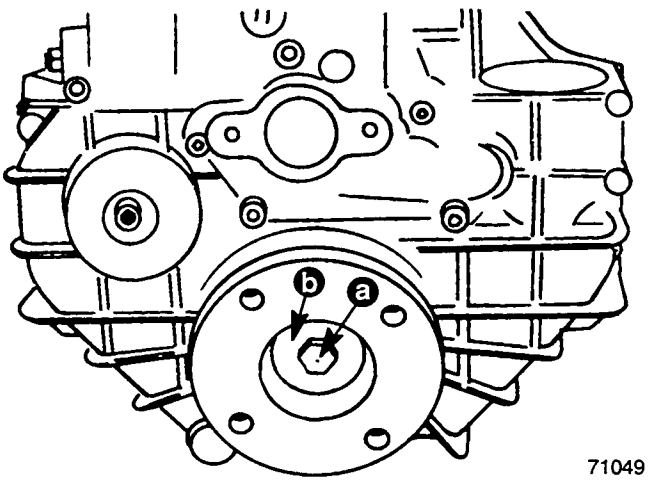
15. Coat output shaft splines with a thin coat of Loctite Type "A."
16. Coat lip of output shaft seal with ATF.
17. Install output shaft flange. Be careful not to damage output shaft seal.



a - Splines
b - Output Shaft Seal

18. Install O-ring into flange and coat with ATF.
19. Install washer and bolt. Torque to 63 lb. ft. (85 N·m).

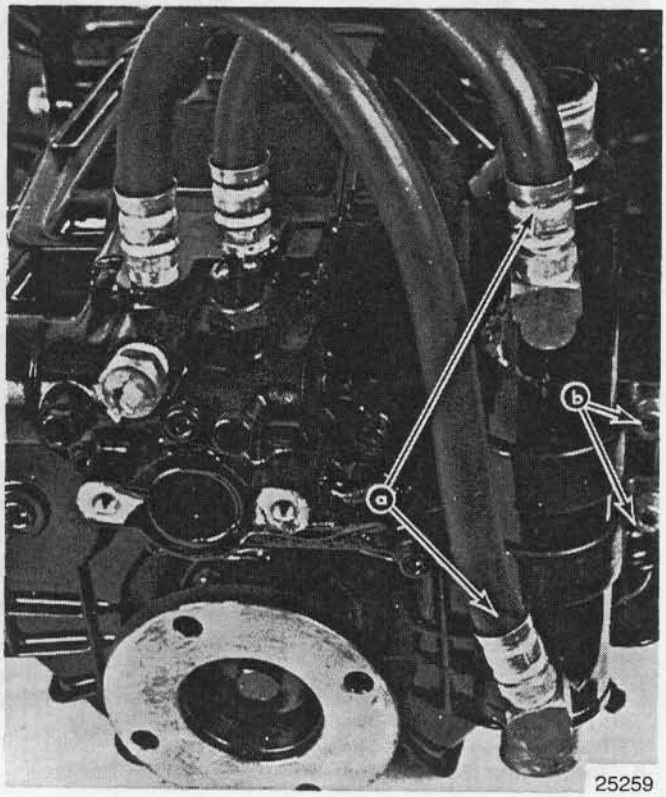




a - Bolt
b - Washer
c - O-ring

TRANSMISSION FLUID COOLER

20. Install transmission fluid cooler on housing. Secure with clamps and screws as shown. Torque to 18 lb. ft. (25 N·m).
21. Connect transmission fluid hoses to cooler as shown. Tighten securely.



25259

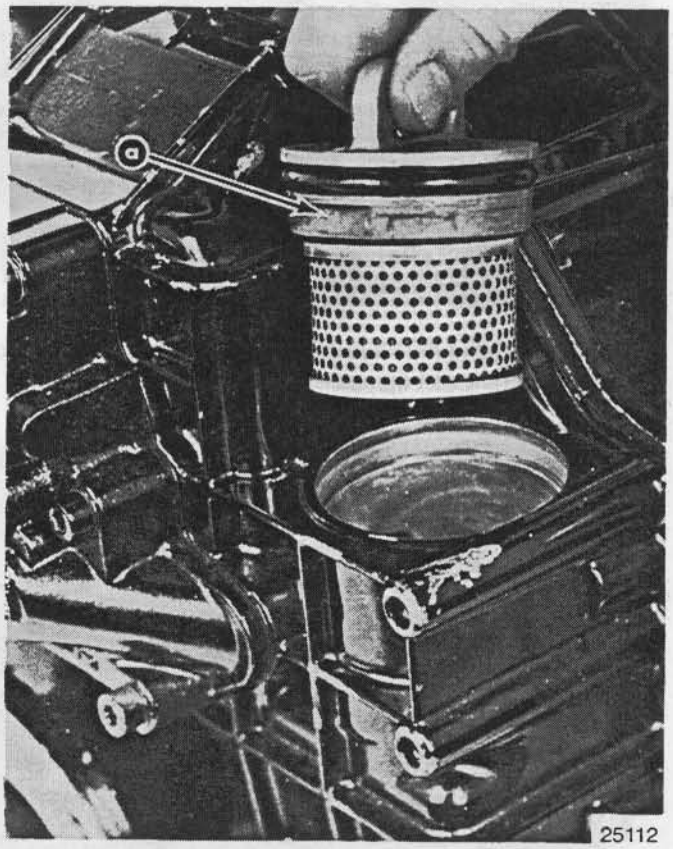
a - Transmission Fluid Hoses
b - Clamps

FILLING WITH TRANSMISSION FLUID

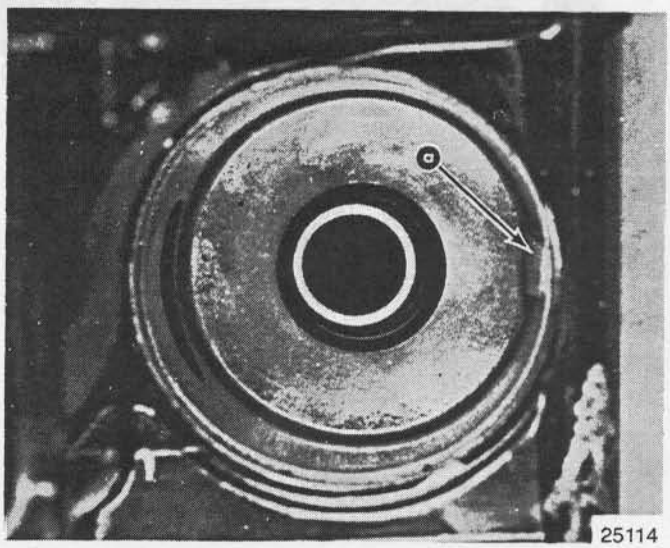
IMPORTANT: Use only ATF (Automatic Transmission Fluid), such as Dexron II-D, or Mobile 423.

22. Fill transmission to proper level, thru oil filter cavity. (Refer to specifications for capacity.)

23. Install filter as follows:
    a. Bring flat spot on filter into agreement with flat surface inside of housing.
    b. Tighten filter by pushing down and turning clockwise at the same time.

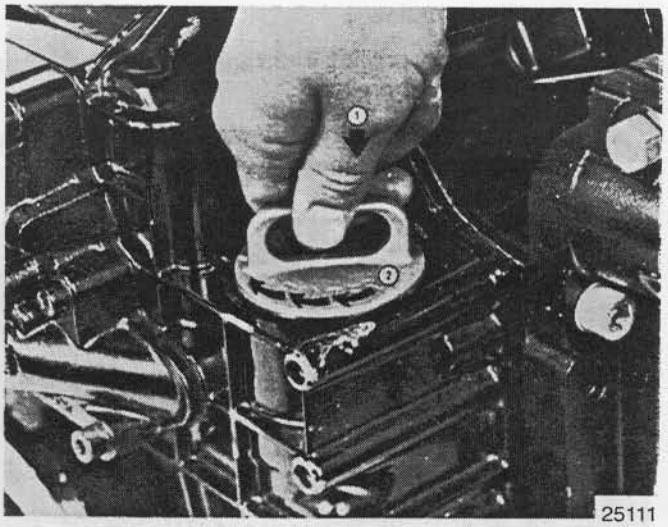


25112

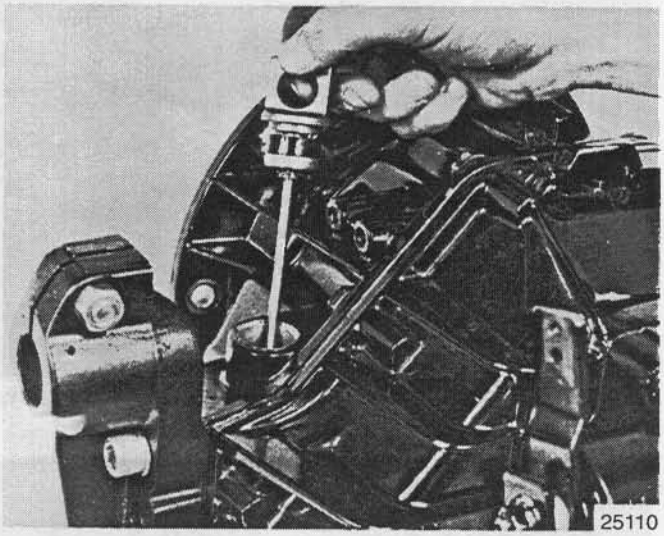


25114

a - Flat Spot

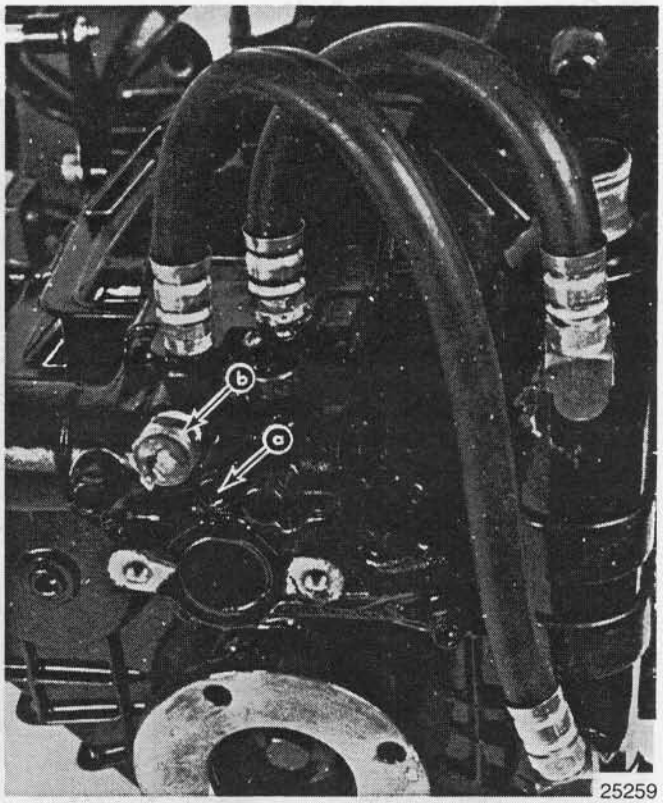

25111

24. Check fluid level. Fluid should be between "Min." and "Max." marks on dipstick.


25110

Functional Test

1. Connect a pressure gauge and thermometer to fluid pump at locations shown.



25259

a - Pressure Gauge (M10x1 Thread) - Remove Plug
b - Thermometer (3/8 in. Thread) - Remove Temperature Sender

2. Perform functional tests as shown in chart following. Refer to "Operating Specifications" for correct readings.

Tests to be carried out:

1. Leakages
2. Noise emission
3. Direction of rotation, LH/RH
4. Lube oil temperature
5. Shifting pressure

The function test should be carried out as follows:

Motor speed rpm	Shift lever position	Duration minutes	Tests		
800-1000	neutral	5	1	2	
600-800 (idling speed)	A ↔ B position repeatedly	—	1	2	3
1500-2500	B position	*	1	2	4
600-800 (idling speed)	A ↔ B position repeatedly	—	1	2	3
Idling-max. speed	A position	—	1	2	5**
600-800	from A → B position	—	1	2	
Idling-max. speed	B position	—	1	2	5**

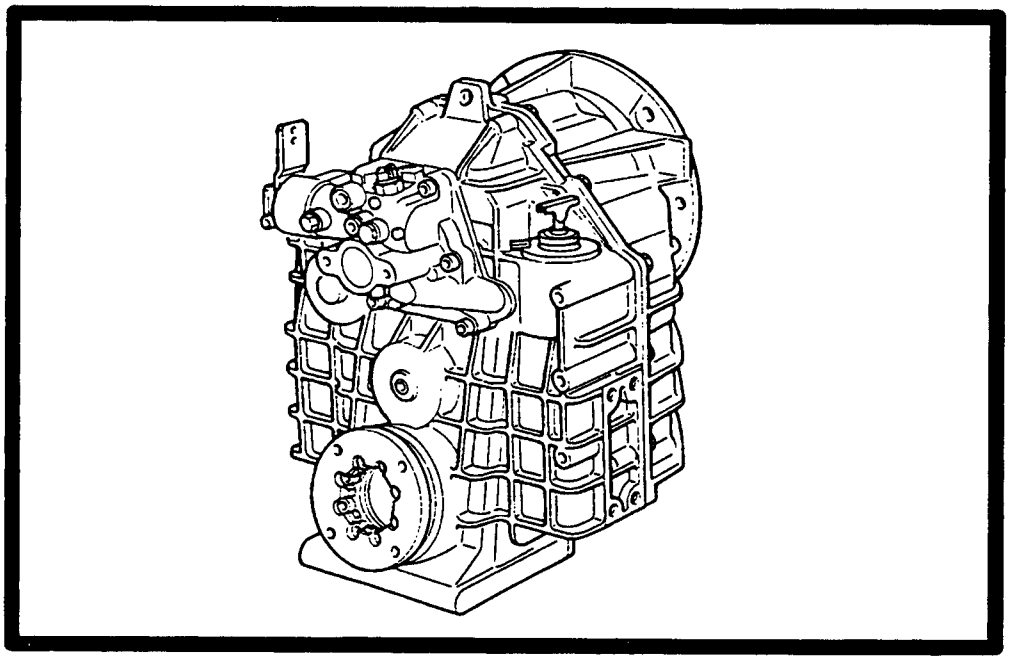
*Until an oil temperature of 75-80° C (167-176° F) has been reached

**at different speeds

DRIVE SYSTEMS

8

D



HURTH V-DRIVE TRANSMISSION

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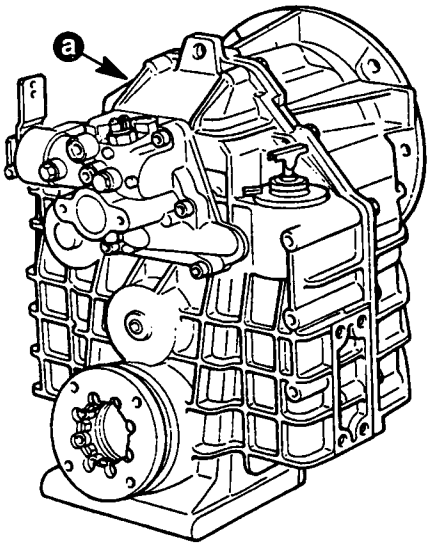
Identification

The transmission identification plate is located on the top rear of the transmission.



merCruiser
TRANSMISSION
BUILT BY HURTH, WEST GERMANY
SERIAL NO.:
RATIO = 1.5 : 1.0

Early Style Identification Plate

HURTH
MÜNCHEN
HSW 630V – 1,5
Getr.-Nr.
i_A = 1,56 i_B = 1,58
MADE IN WEST-GERMANY 71039

Late Style Identification Plate

a - Transmission Identification Plate
(Stating: Serial Number and Gear Ratio)

Torque Specifications

FASTENER LOCATION	Lb. Ft. (N·m)
Transmission Housing Halves Bolts and Nuts	36 lb. ft. (49 N·m)
Control Block to Housing Bolts	18 lb. ft. (25 N·m)
Output Flange	14 lb. ft. (18 N·m)
Mounts	50 lb. ft. (68 N·m)
Transmission to Flywheel Housing	50 lb. ft. (68 N·m)

Specifications

OPERATING SPECIFICATIONS	
Shifting Pressure	312-377 psi (2151-2599 kPa)
Operating Temperature	130° - 250° F (54° - 121° C)

Lubricants/Sealants

ATF - Dexron II - D	Obtain Locally
Loctite Type "A" (Screws/Bolts/Flange)	Obtain Locally
Loctite 515 (Split-Line)	Obtain Locally

Capacity

Model	U.S. Qts. (litres)
Hurth V-Drive[1]	5 (4.7)

[1] Always use dipstick to determine exact quantity of oil required.

Special Tools

MERCURY MARINE SPECIAL TOOLS	
Description	**Part No.**
Tapered Roller Bearing Inner Race Puller	91-813950
Tapered Roller Bearing Outer Race Puller	91-813951
Pressure Plate Removal Tool - Reversing Clutch	91-813952
Tapered Roller Bearing Inner Race Puller Plate	91-813953
Mandrel - Input Shaft Seal	91-813955
Mandrel - Output Shaft Seal	91-813956
Preload Tool - Input Shaft	91-813957
Preload Tool - Intermediate Shaft	91-813958
Flange Puller Plate	91-

OTHER SPECIAL TOOLS	
Pressure Gauge, 0-450 psi (M10x1 Thread)	Obtain Locally
Thermometer [(3/8 in. Thread, 0° - 270° F (-18° - 132° C)]	Obtain Locally

General

The Hurth transmission is a "full power reversing" transmission, allowing a standard (LH rotation) engine to be used for both rotations. Propeller rotation is determined by shift cable attachment at the remote control.

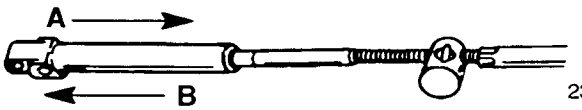
NOTE: All engines are LH rotation as viewed from flywheel end of engine.

⚠CAUTION

Avoid severe transmission damage. All Hurth transmissions require standard left-hand rotation engines. NEVER connect a Hurth transmission to a right-hand rotation engine.

IMPORTANT: Transmission propeller rotation is determined by the shift cable installation in the remote control.

- RIGHT HAND ROTATION - Control cable will have to be installed in remote control so that cable end will move in direction "A" when shift handle is placed in the forward position.
- LEFT HAND ROTATION - Control cable will have to be installed in remote control so that cable end will move in direction "B" when shift handle is placed in the forward position.



23242

"A" is Forward Gear for RH Rotation Propeller
"B" is Forward Gear for LH Rotation Propeller

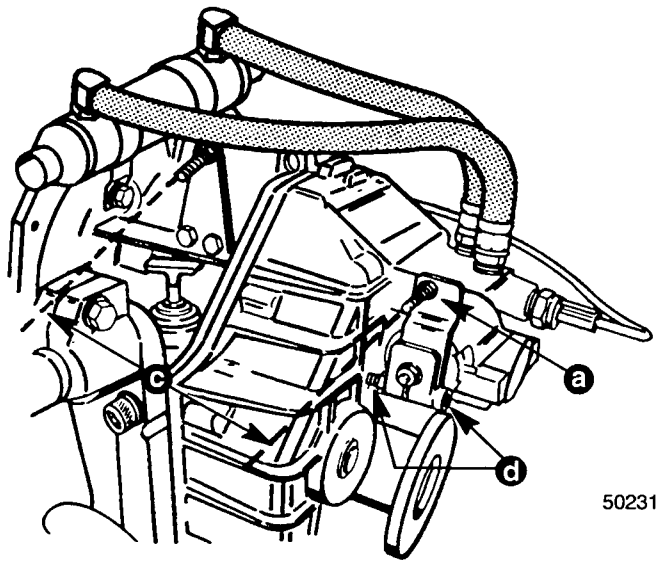
Shifting lever in position	Propeller rotation	Propeller
A	Opposite to engine rotation	Right hand (RH)
B	Same as engine rotation	Left hand (LH)

TRANSMISSION RATIOS

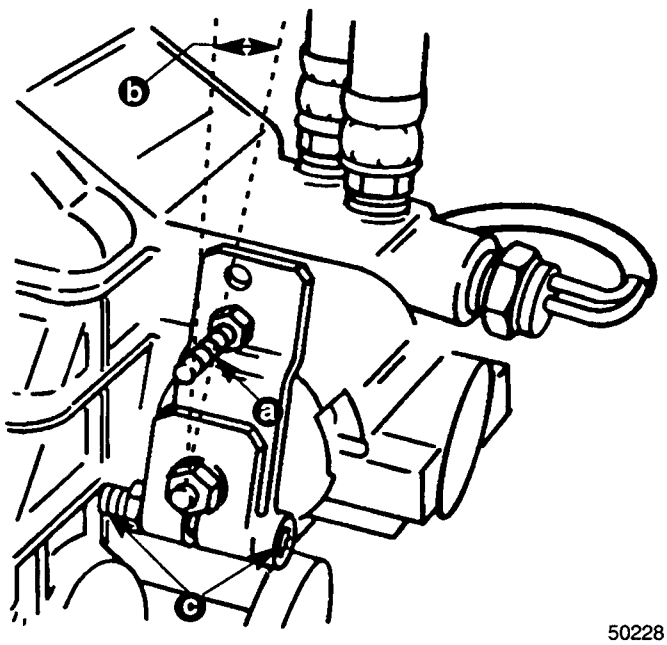
Nominal transmission ratio	1.5	2.0	2.5
Transm. ratio shifting pos. "A" (forward gear)	1.56	1.99	2.48
Transm. ratio shifting pos. "B" (reverse gear)	1.57	2.03	2.53

Shift Cable Installation and Adjustment

IMPORTANT: Check that shift lever is positioned approximately 10° of vertical aft as shown when in the neutral detent position and that the distance between studs in the following is set at 7-1/8 in. (317.5mm). If necessary, loosen clamping bolt and position lever so that dimension "c" is as shown when in the neutral detent position, and retighten clamping bolt.



50231

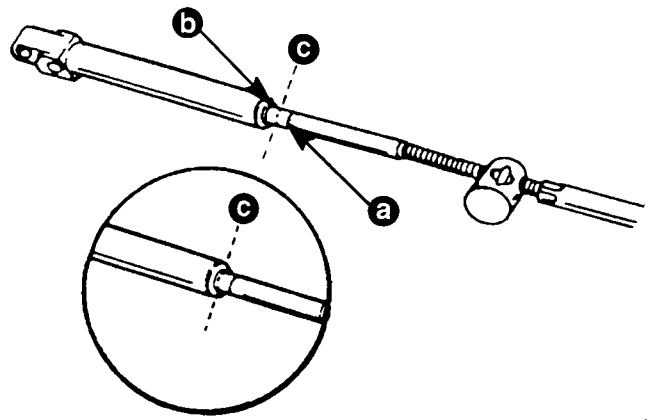


50228

a - Shift Lever
b - Lever, in Neutral Detent, Must Be Approximately 10 Degrees Aft of Vertical
c - Dimension between Studs - 7-1/8 in. (317.5mm)
d - Clamping Bolt

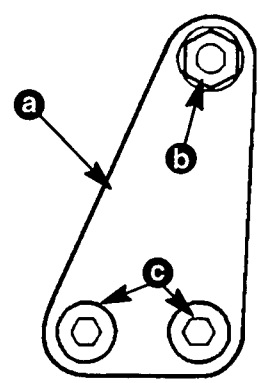
Typical Hurth Transmission Shown

1. Place remote control shift lever, and transmission shift lever, in neutral position.
2. Locate center of remote control and control shift cable play (backlash) as follows:
   a. Check that remote control is in neutral position.
   b. Push in on control cable end with enough pressure to remove play, and mark position "a" on tube.
   c. Pull out on control cable end with enough effort to remove play, and mark position "b" on tube.
   d. Measure distance between marks "a" and "b", and mark position "c", half-way between marks "a" and "b".



22024

3. The shift cable anchor stud bracket should be installed. Anchor stud for shift cable should be installed as shown.



71040

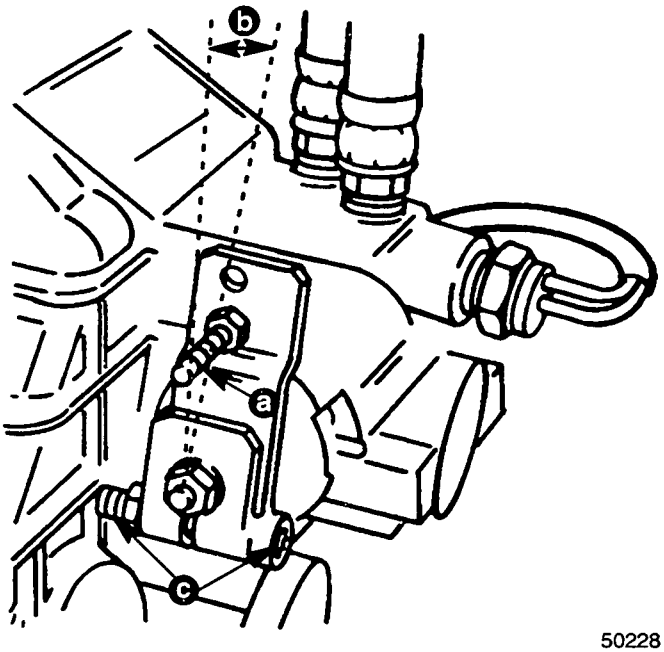
a - Bracket, Shift Cable
b - Shift Cable Anchor Stud
c - Bracket-to-Transmission Fasteners

Shift Cable Bracket Shown

4. Center cable-end play, then adjust cable barrel to align holes in barrel and in cable end guide with attaching points on transmission.
5. Temporarily install shift cable. Do not secure at this time.

IMPORTANT: Transmission is "fully" in gear when shift lever comes to a stop, in either direction.

6. Place remote control shift lever in forward gear position. Check to ensure transmission is fully in gear, as follows:
   a. Hold shift lever in position.
   b. Carefully slide shift cable off of anchor points.
   c. Attempt to move transmission shift lever further.
7. Temporarily install shift cable onto anchor points again. Do not secure at this time. Place remote control shift lever in the reverse gear position. Check that transmission is fully in gear, following the same procedure as outlined above.
8. If transmission shift lever will position properly in one gear, but not in the other, recheck shift cable adjustment. If transmission shift lever will not position properly in both gears, move transmission shift lever stud (a), from top hole in shift lever, to bottom hole, and recheck for proper positioning. If proper positioning is still not obtained, remote control does not provide sufficient shift cable travel and must be replaced.



50228

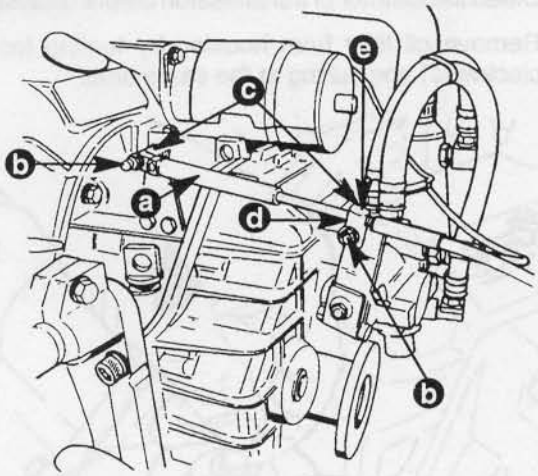
a - Shift Lever Stud
b - Lever, in Neutral Detent, Must Be Approximately 10 Degrees Aft of Vertical
c - Clamping Bolt

9. Once shift cable adjustment is correct, secure shift cable(s) with hardware as shown following, referring to appropriate configuration following.

NOTE: To change cable approach direction on single or dual station installations, only the spacer/bushings have to be switched to the opposite stud (the studs are identical).

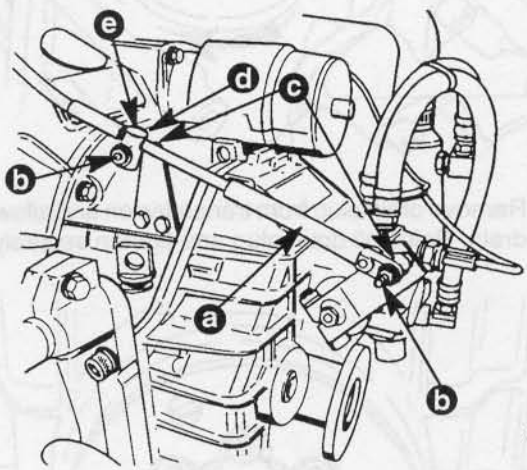
SINGLE STATION INSTALLATIONS

TRANSOM APPROACH

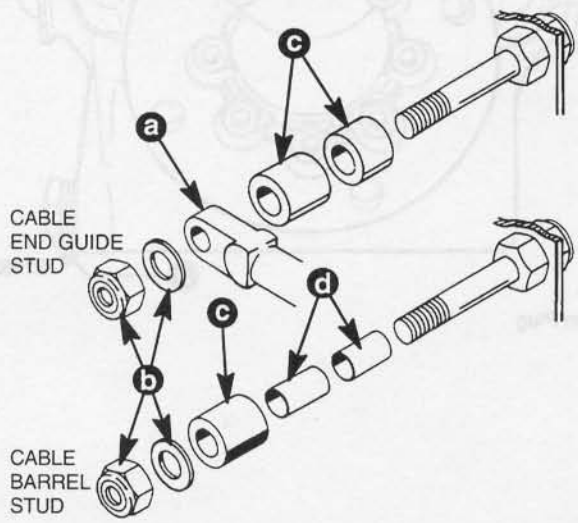


50074

FRONT APPROACH



50074

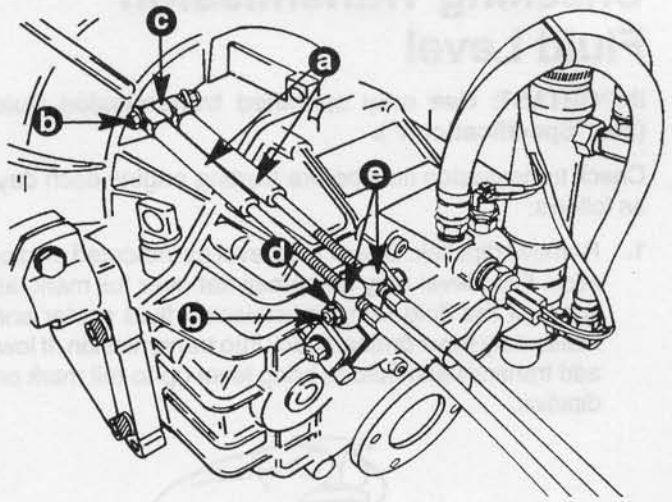


50229

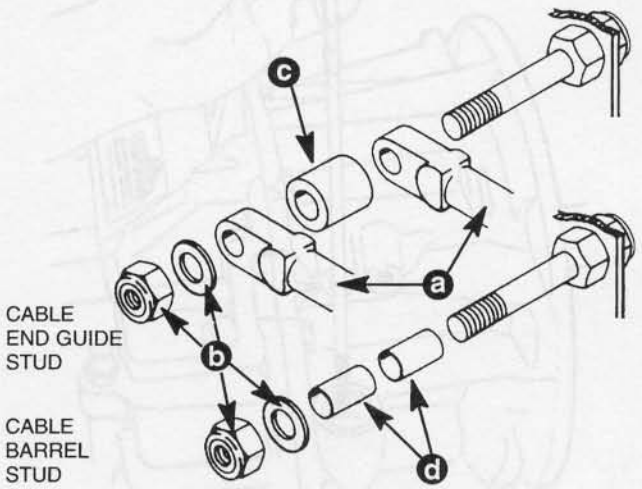
Typical Hurth Transmission Shown

a - Cable End Guide
b - Elastic Stop Nut and Washer
c - Spacer
d - Bushings
e - Cable Barrel

DUAL STATION INSTALLATIONS



50075



50073

Typical Hurth Transmission (Transom Approach Shown, Front Approach Similar)

a - Cable End Guide
b - Elastic Stop Nut and Washer
c - Spacer
d - Bushings
e - Cable Barrel

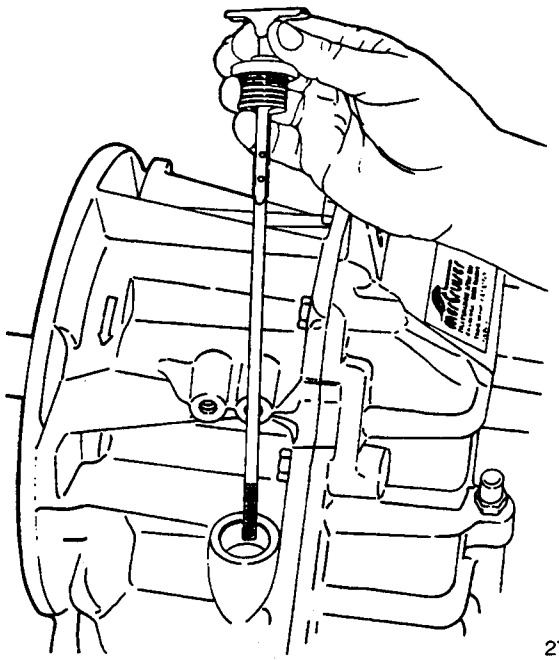
NOTE: To change cable approach direction on single or dual station installations, only the spacers/bushings have to be switched to the opposite stud (the studs are identical.)

Checking Transmission Fluid Level

IMPORTANT: Use only specified transmission fluid (see "Specifications").

Check transmission fluid before starting engine each day, as follows:

1. Remove dipstick. Check fluid level as indicated on dipstick. Fluid level may be somewhat over full mark, as some of the fluid from transmission fluid cooler and hoses may have drained back into transmission. If low, add transmission fluid to bring level up to full mark on dipstick.



27661

IMPORTANT: To accurately check fluid level, engine must be run at 1500 RPM for 2 minutes immediately prior to checking level.

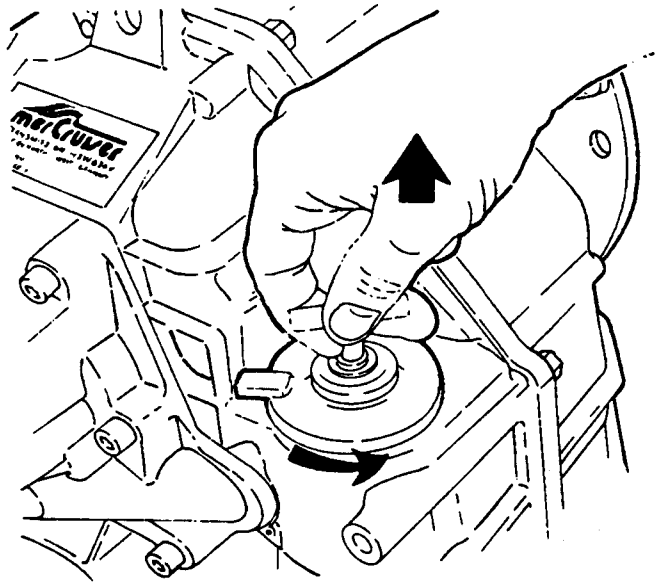
2. Start engine and run at 1500 RPM for 2 minutes to fill all hydraulic circuits.

IMPORTANT: Be sure to push dipstick all-the-way down into dipstick tube when checking fluid level.

3. Stop engine and quickly check fluid level. Add automatic transmission fluid, if necessary, to bring level up to full mark on dipstick. (Refer to "Filling Instructions", following.)
4. Reinstall dipstick.
5. If transmission fluid level was extremely low, carefully check transmission, fluid cooler and hoses for leaks.

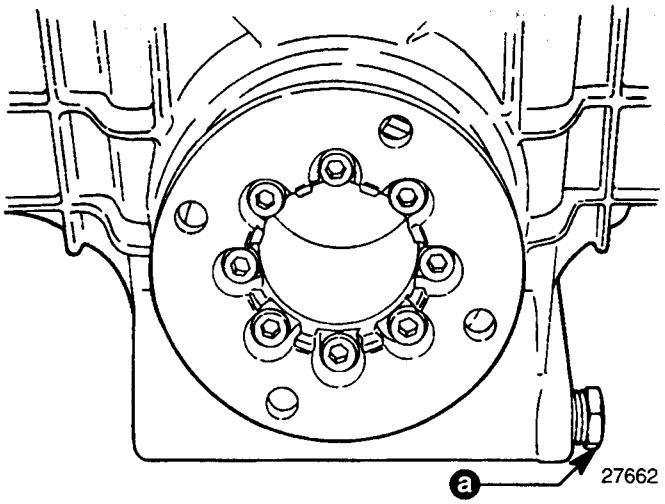
Draining Transmission

1. Clean the exterior of transmission before disassembly.
2. Remove oil filter from housing by turning (counter-clockwise) and pulling at the same time.



27666

3. Remove drain plug from transmission and allow fluid to drain. Reinstall drain plug and tighten securely.



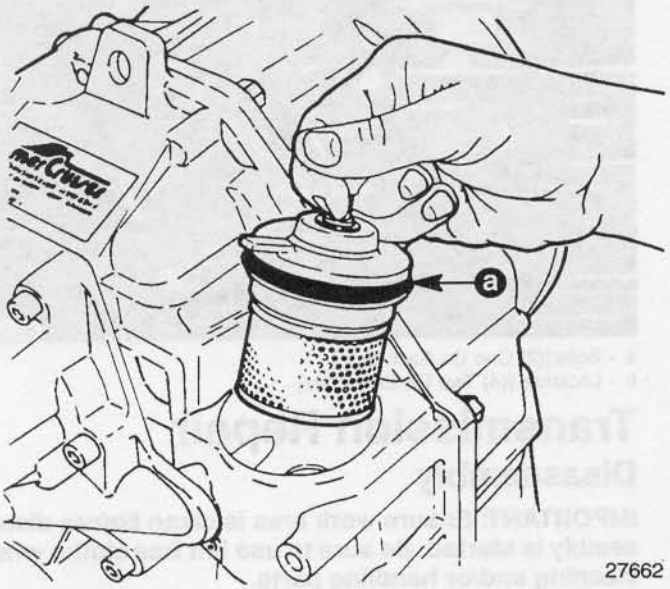
27662

a - Drain Plug

Filling Transmission

IMPORTANT: Use only Automatic Transmission Fluid (ATF) as recommended in "Specifications."

1. Fill transmission to proper level, thru oil filter cavity. (Refer to specifications for capacity.)
2. Install filter as follows:
   a. Coat O-ring on filter cover with transmission fluid.



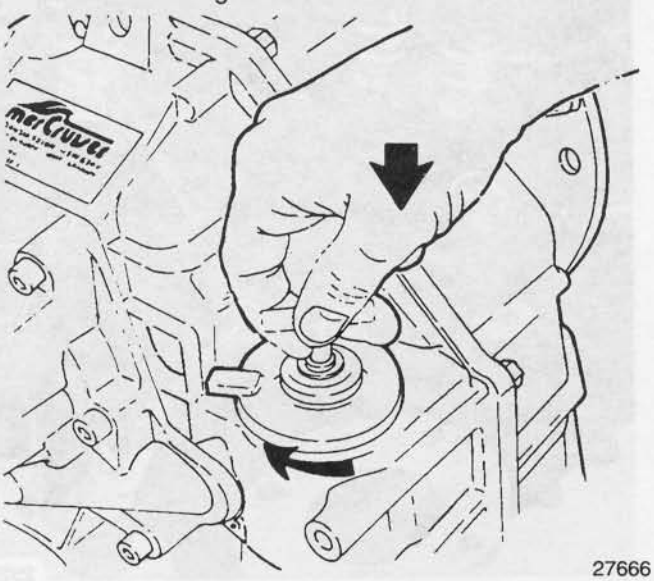
27662

a - O-Ring

⚠ CAUTION

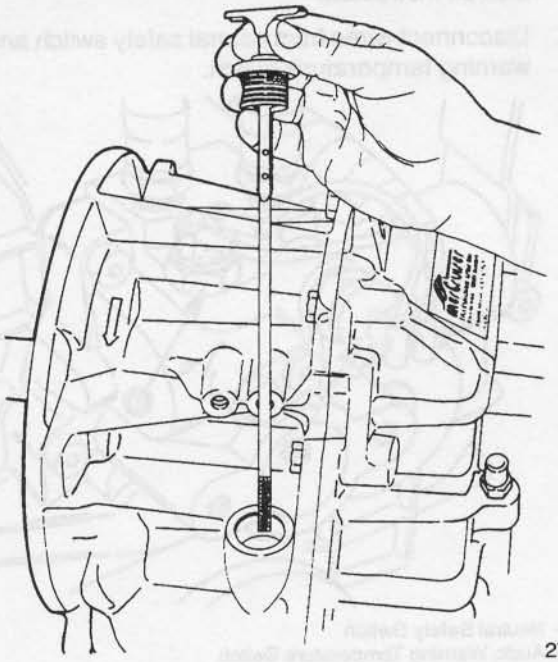
Transmission fluid filter and cover must be properly seated to avoid fluid foaming and/or loss of fluid, thus resulting in decreased efficiency and/or damage to transmission.

   b. Push down until cover is fully seated (top of cover flush with housing), then, turn "T"-handle clockwise until tight.



27666

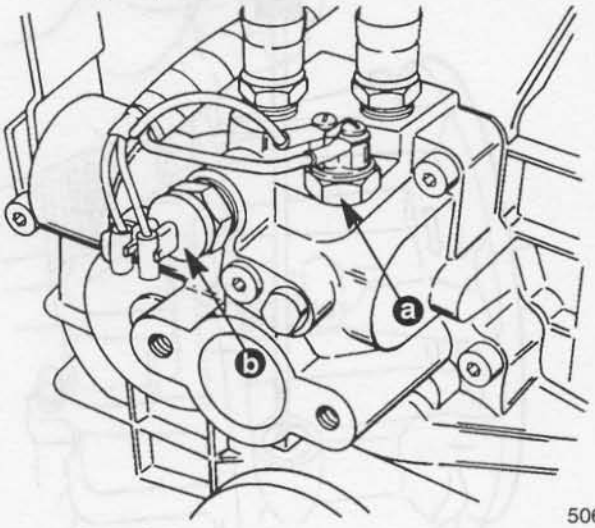
3. Start engine and run for two minutes to fill system with fluid.
4. Stop engine and check fluid level. Fluid should be between "Min" and "Max" lines on dipstick.



27661

Transmission Removal

1. Refer to Removal and Installation, Section 2F – "MIE (Inboard) Models" and remove engine and transmission as instructed.
2. Disconnect wires from neutral safety switch and audio warning temperature switch.

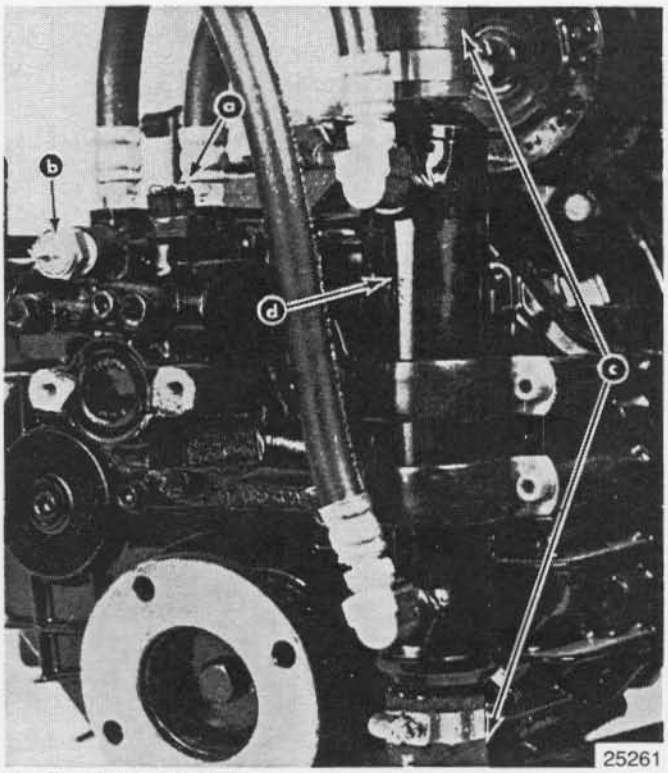


50686

a - Neutral Safety Switch
b - Audic Warning Temperature Switch

Typical Hurth Transmission Shown

3. Disconnect seawater hoses from transmission fluid cooler.

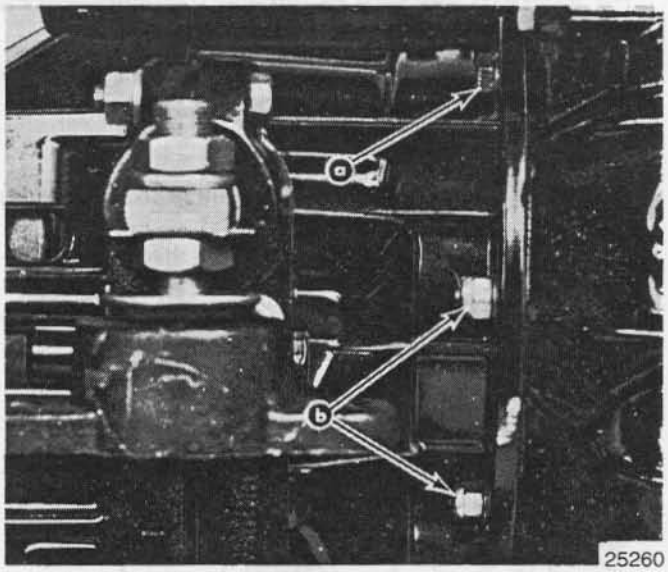


25261

a - Neutral Safety Switch
b - Audio Warning Temperature Switch
c - Seawater Hoses

Typical Hurth Transmission Fluid Cooler Shown (All Similar)

4. Remove bolts (2) and locknuts (4) and remove transmission.



25260

a - Bolts [(2) One On Each Side]
b - Locknuts [(4) Two On Each Side]

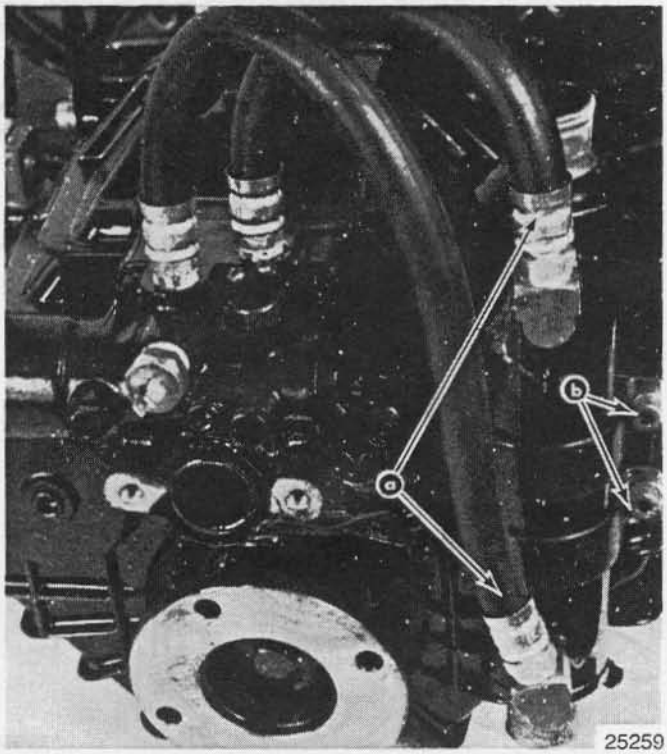
Transmission Repair

Disassembly

IMPORTANT: Ensure work area is clean before disassembly is started. Be sure to use lint free cloths when cleaning and/or handling parts.

TRANSMISSION FLUID COOLER/HOSES

1. Follow instructions "a" - "c":
   a. Disconnect transmission fluid hoses from cooler and remove clamps that secure cooler to housing.

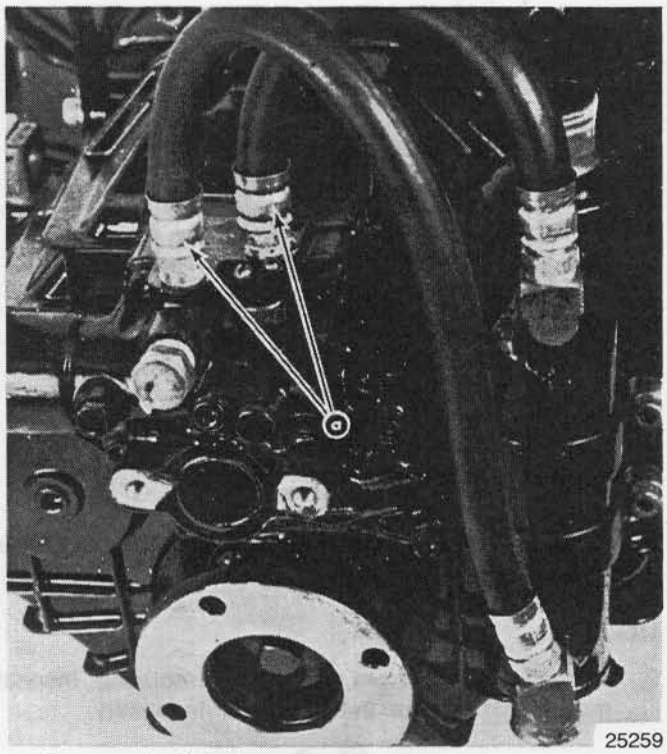


25259

a - Transmission Fluid Hoses
b - Clamps

b. Remove cooler.

c. Remove transmission fluid hoses from transmission. (Note position of longer hose to aid in reassembly.)

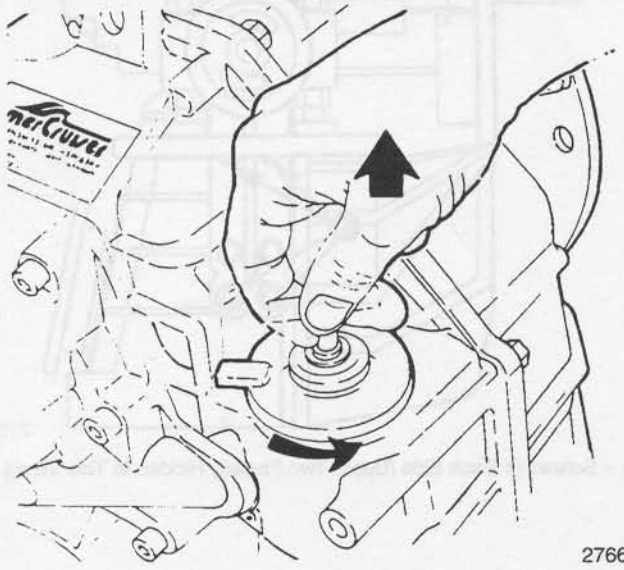


25259

a - Transmission Fluid Hoses
b - Clamps

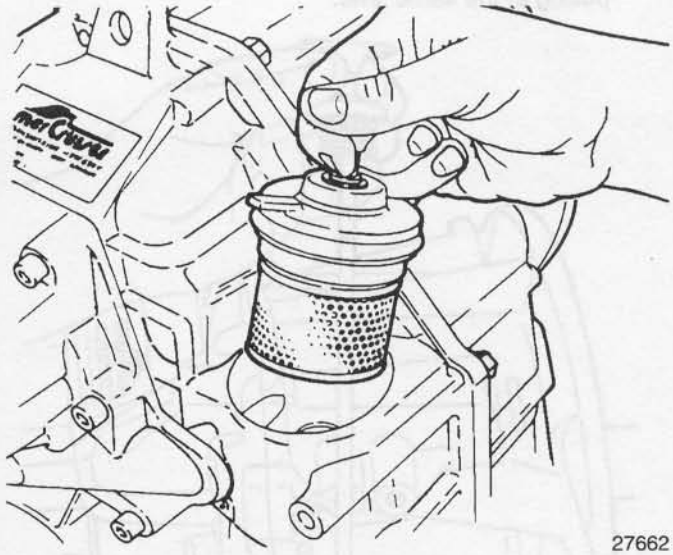
OIL FILTER and DIPSTICK

2. Remove oil filter from housing by turning "T"-handle counterclockwise and pulling up on cover.



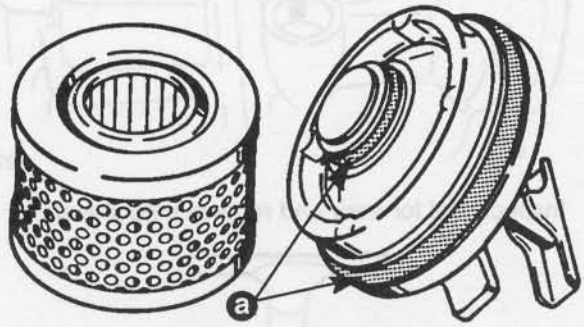
27666

3. Remove filter element from cover.



27662

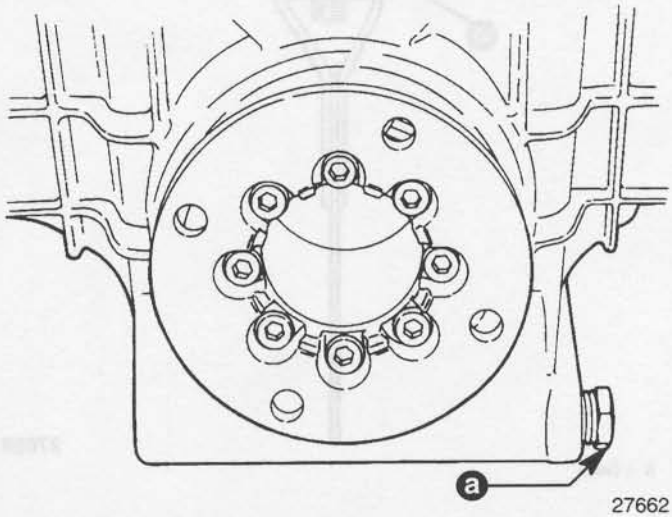
4. Inspect O-rings for wear and replace if necessary.



50975

a - O-rings

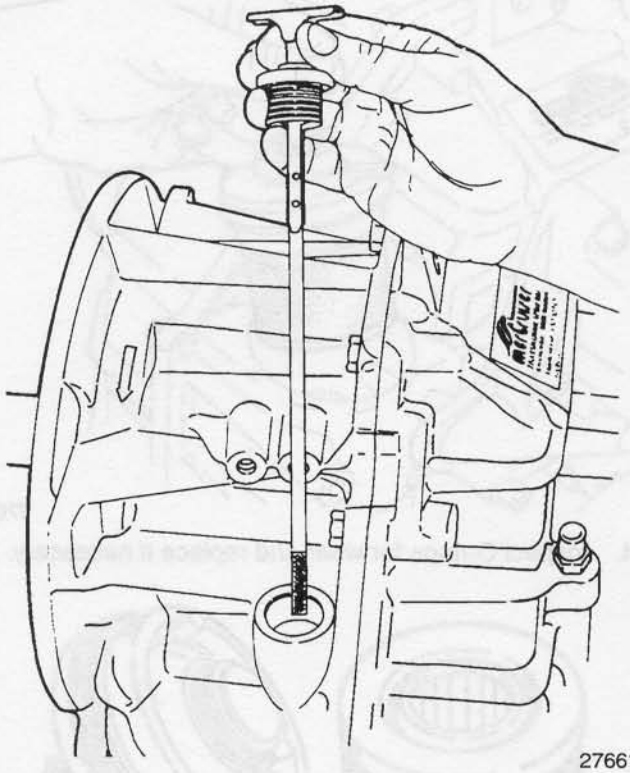
5. Remove drain plug from transmission and allow fluid to drain. Reinstall drain plug and tighten securely.



27662

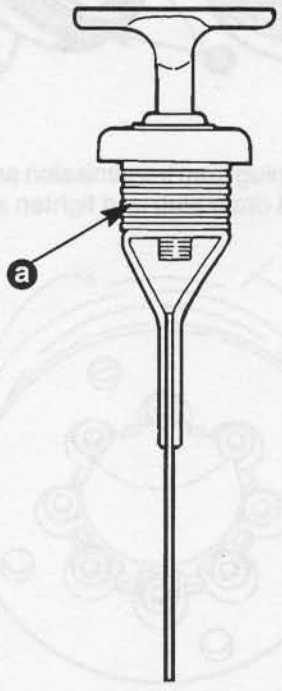
a - Drain Plug

6. Remove dipstick by turning (counterclockwise) and pulling at the same time.



27661

7. Inspect seal for wear and replace if necessary.

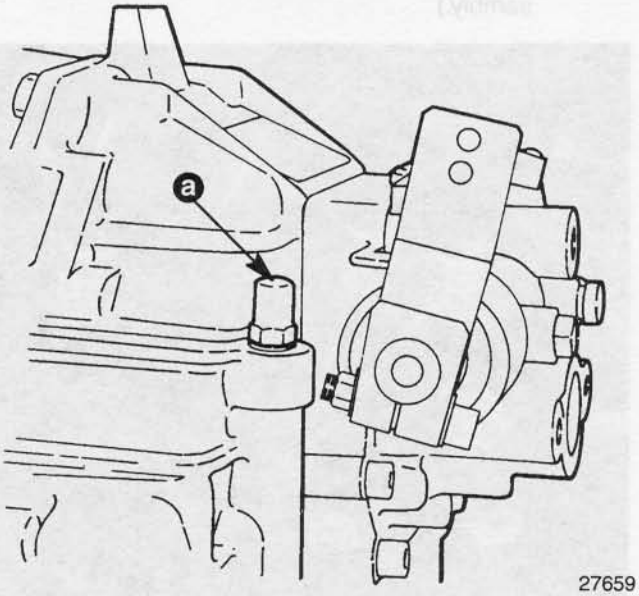


27659

a - Seal

BREATHER VALVE

8. Remove breather valve. Clean with suitable cleaner, allow to dry and coat with oil.

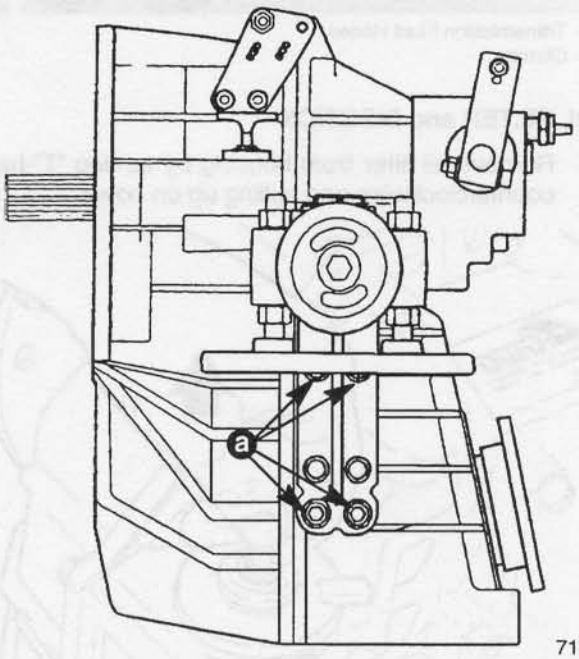


27659

a - Breather Valve

MOUNTS

9. Remove mounts from transmission housing. Inspect mounts for damage and replace if necessary.

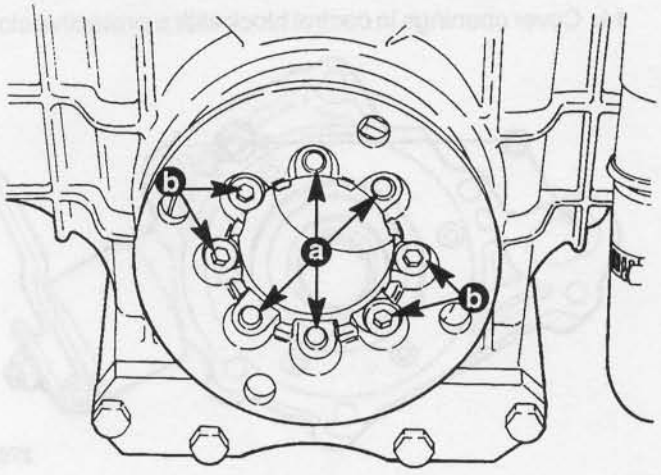


71020

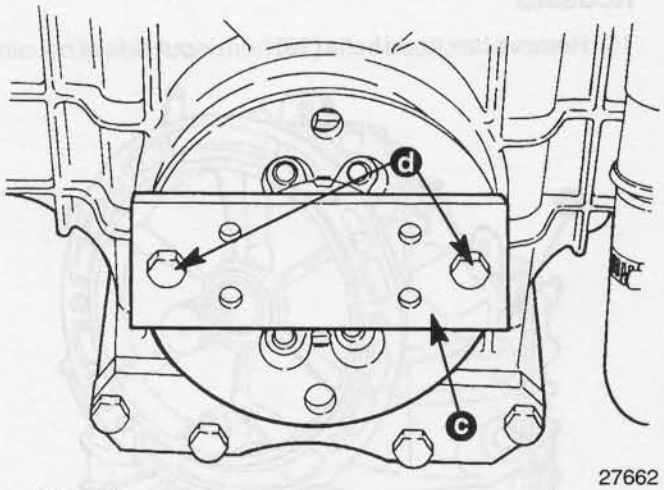
a - Screws [4 Each Side (Upper Two Partially Hidden In This View)]

OUTPUT FLANGE

10. Remove 4 bolts as shown and loosen but do not remove 4 remaining bolts. Install flange puller plate on output flange and secure with bolts and nuts.



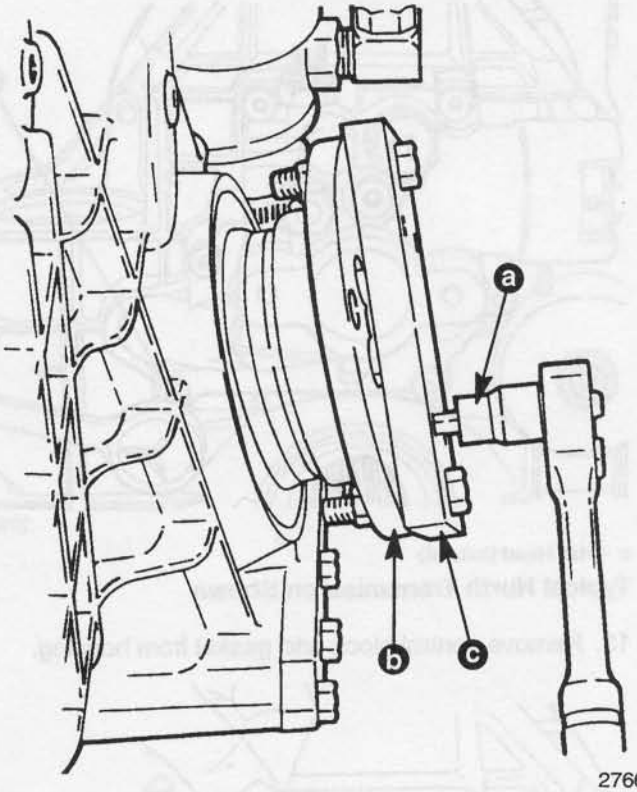
27663



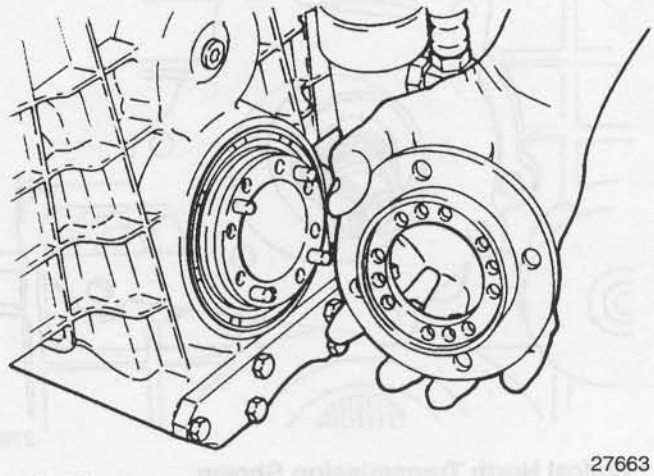
27662

a - Bolts - Remove
b - Bolts - Loosen (Do Not Remove)
c - Flange Puller Plate
d - Bolts and Nuts

11. Turn 4 remaining bolts out until they just contact flange puller plate. Then, continue to turn bolts out evenly (to push on puller plate) to remove flange.



27663

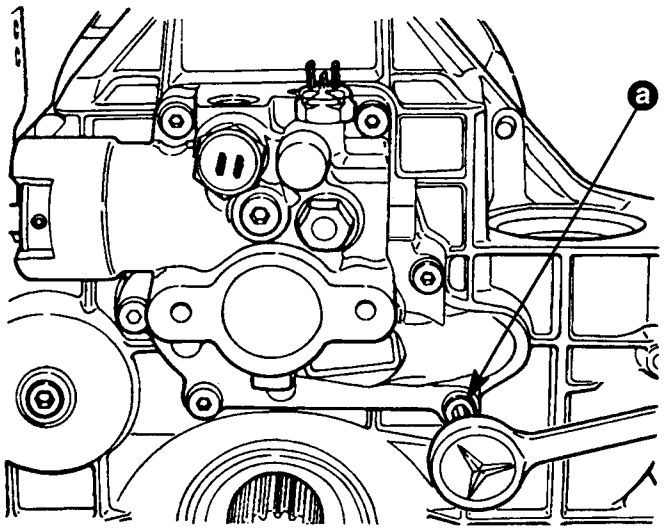


27663

a - Hex Wrench
b - Flange
c - Flange Puller Plate

CONTROL BLOCK

12. Remove hex head bolts (6).

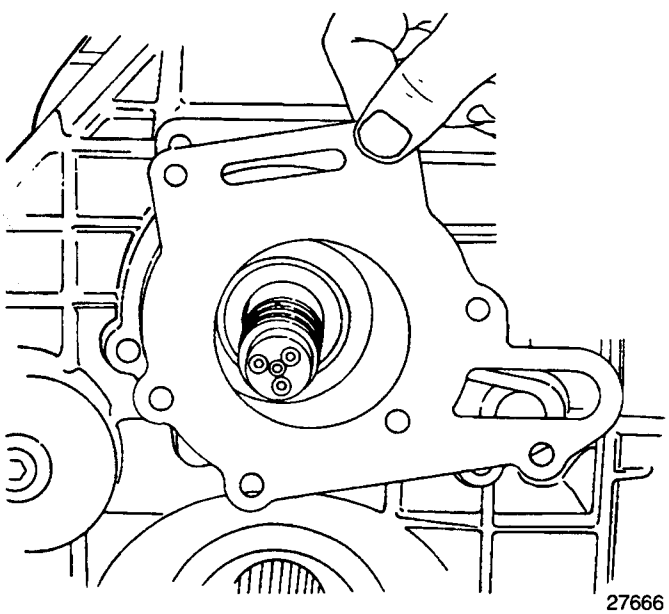


27661

a - Hex Head Bolts (6)

Typical Hurth Transmission Shown

13. Remove control block and gasket from housing.



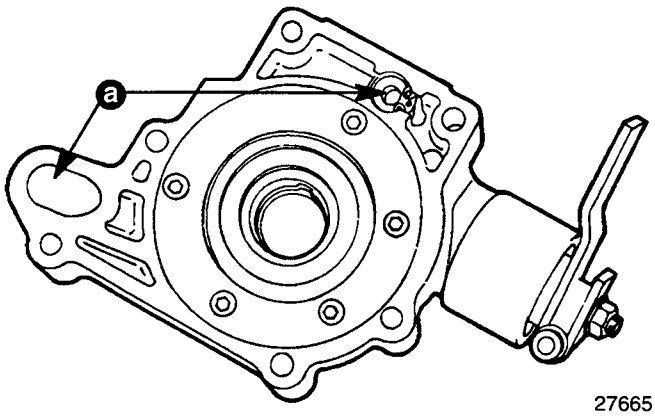
27666

Typical Hurth Transmission Shown

⚠CAUTION

Be careful not to allow dirt to enter control block from front side.

14. Cover openings in control block with a protective cloth.

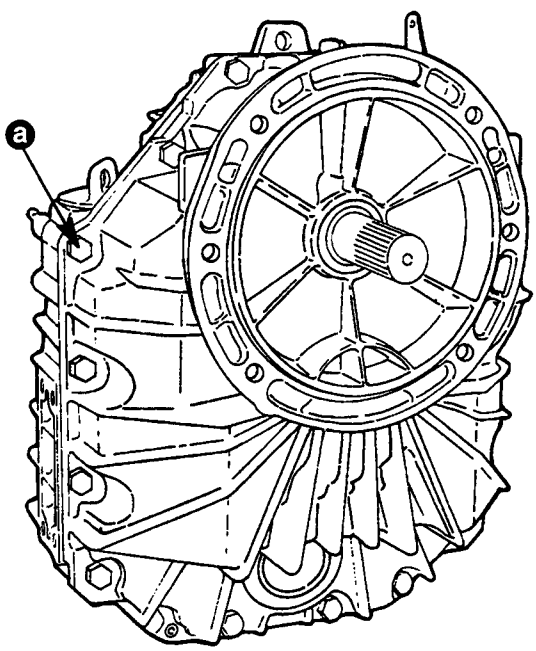


27665

a - Openings

HOUSING

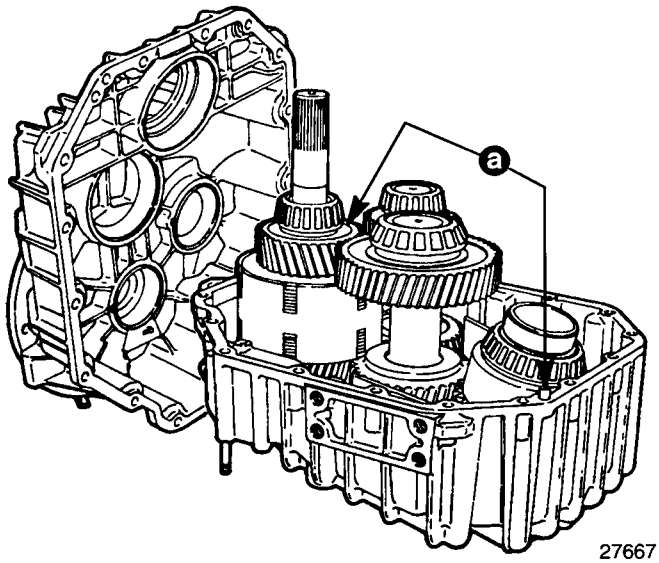
15. Remove hex head bolts (16) from input side of housing.



27659

a - Hex Bolts

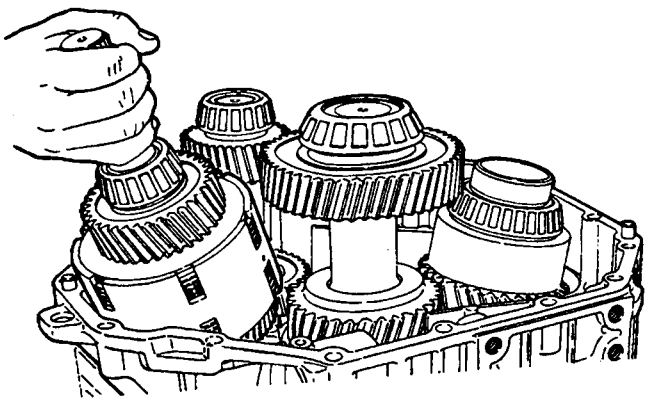
16. Remove input side of housing. Be sure to locate and save locator pins.



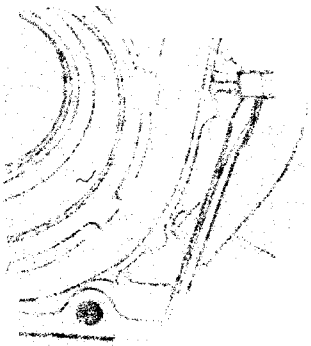
27667

a - Locator Pins

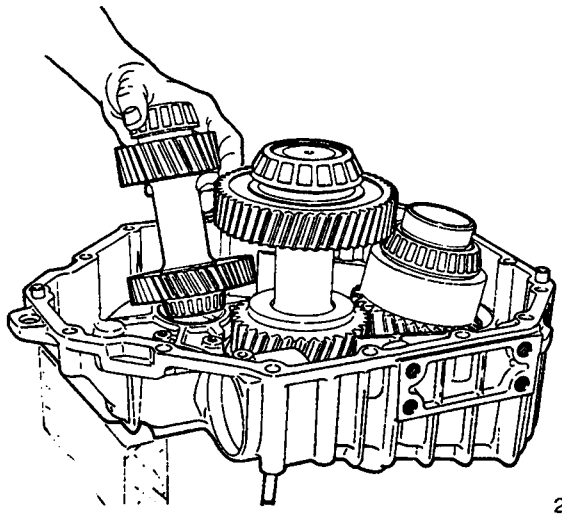
17. Remove input shaft assembly.



27667

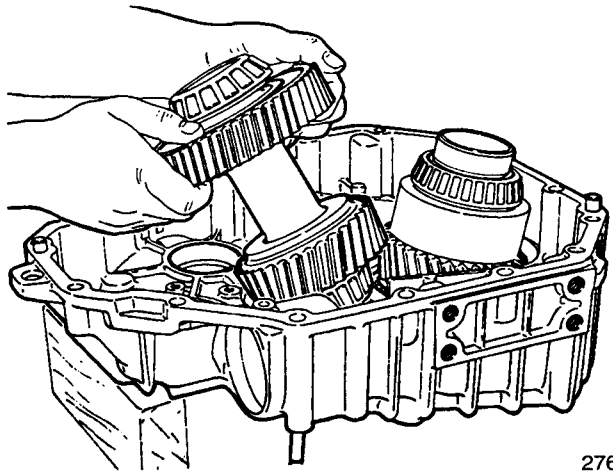


18. Remove intermediate shaft assembly.



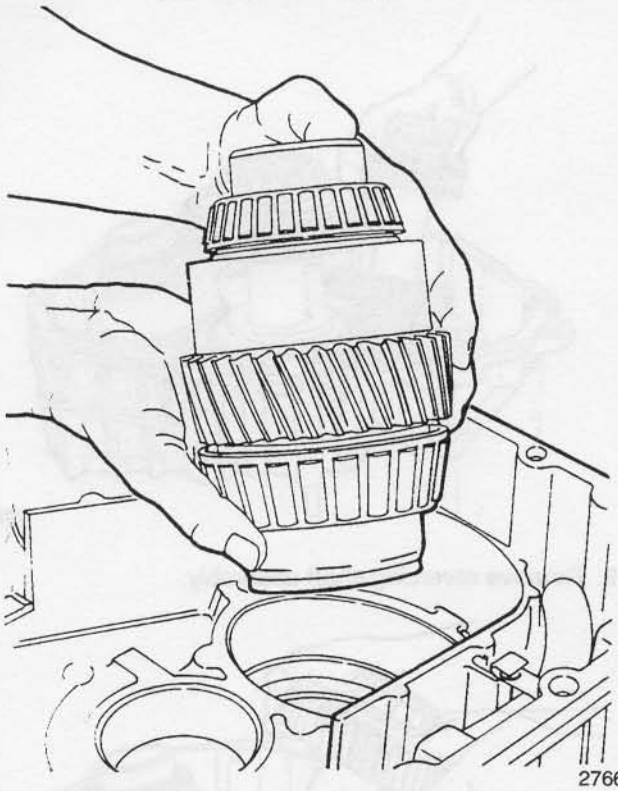
27667

19. Remove reversing shaft assembly.



27668

20. Remove output shaft assembly.



27668

BEARING, GEAR and SEAL INSPECTION

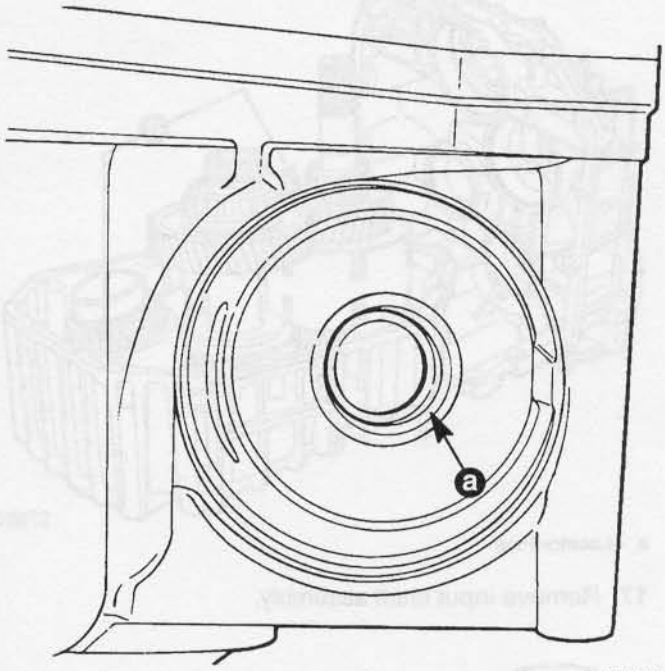
21. Inspect all tapered roller bearings, the piston rings on the input shaft and all gears for wear. If damage has been found on the gearing, it is ALWAYS necessary to replace the complete shaft.

    When gears on the input shaft have to be replaced, the tapered roller bearings and needle bearings MUST BE replaced as well.

22. Turn gears of input shaft to check correct operation of the reversing clutch. If it is hard to turn the gears, the clutch is probably damaged.

SEALS

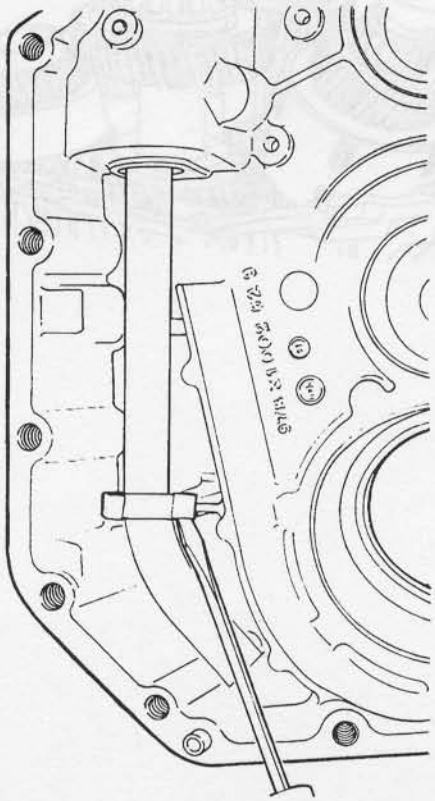
23. Remove suction pipe seal as follows:



27666

a - Seal

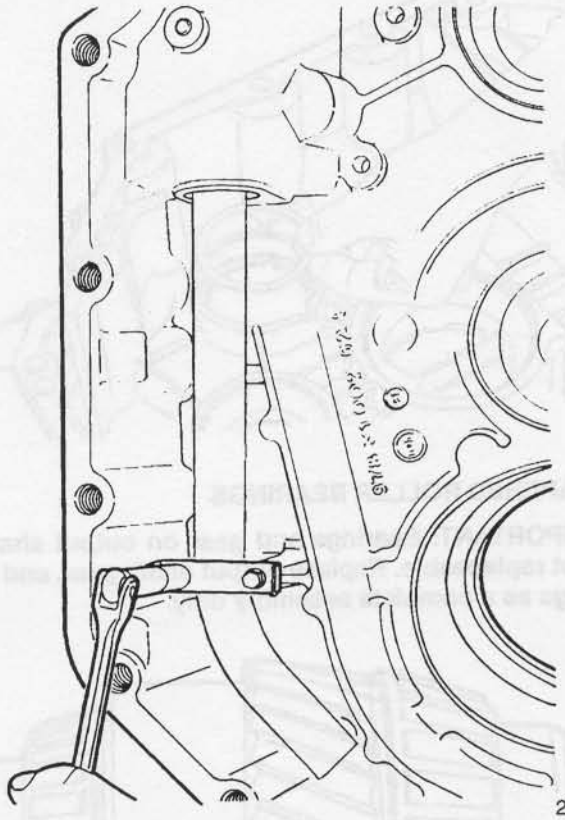
a. Bend tabs up away from screws.



27664

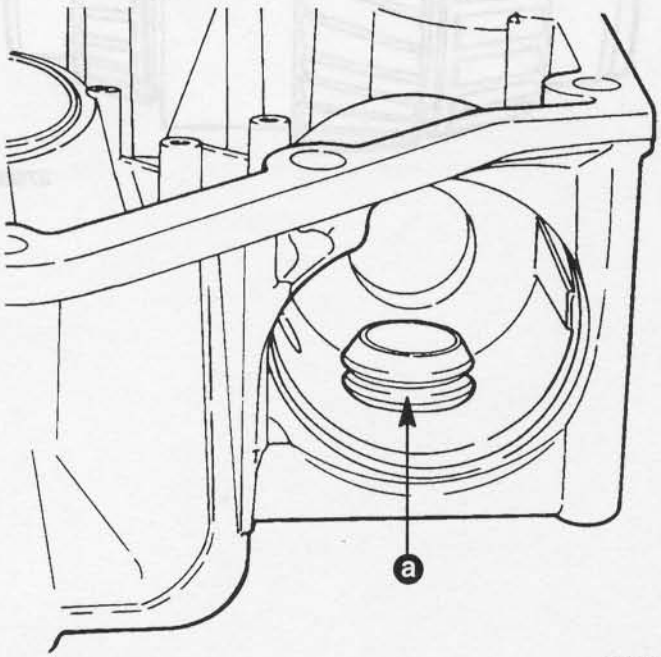
b. Remove screws and hold down plate.

c. Remove suction pipe by pulling downward out of seal.



27665

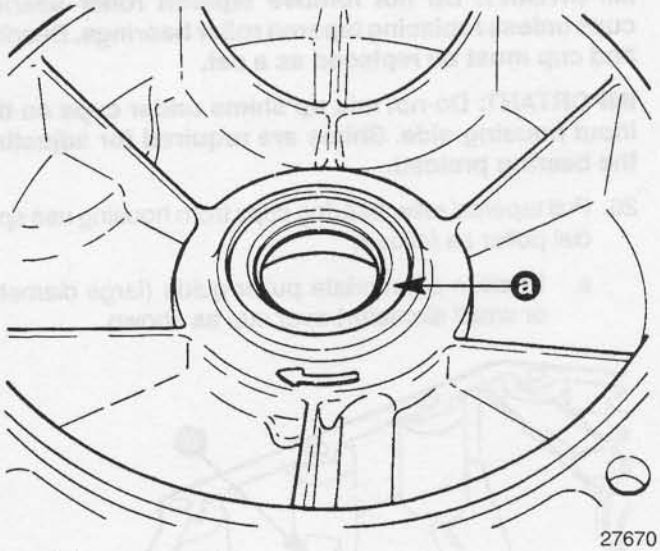
d. Remove seal from top side.



27660

a - Seal

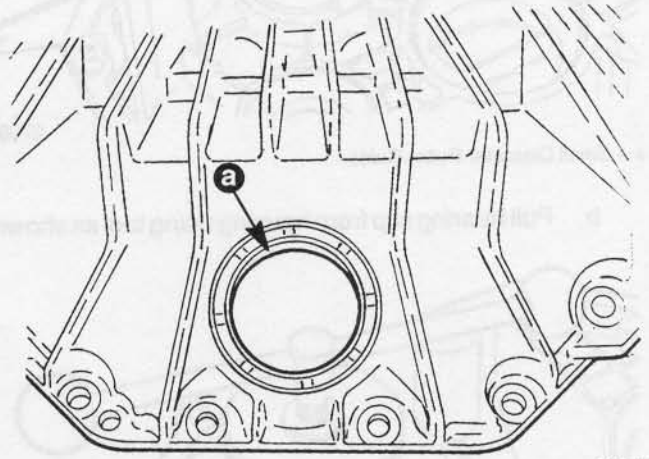
24. Remove input shaft seal using appropriate mandrel.



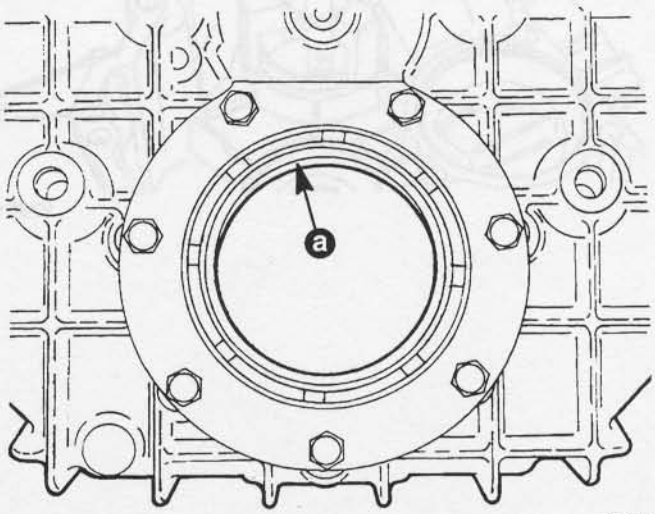
27670

a - Seal

25. Remove output shaft seals using appropriate mandrel.



27669



27669

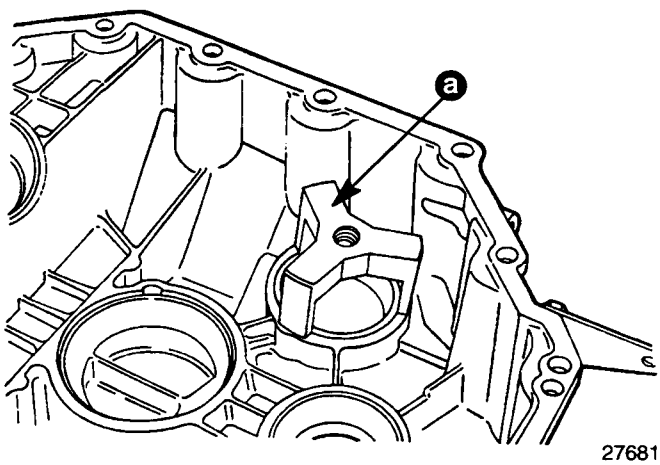
a - Seals

TAPERED ROLLER BEARING CUPS

IMPORTANT: Do not remove tapered roller bearing cups unless replacing tapered roller bearings. Bearing and cup must be replaced as a set.

IMPORTANT: Do not mix up shims under cups on the input housing side. Shims are required for adjusting the bearing preload.

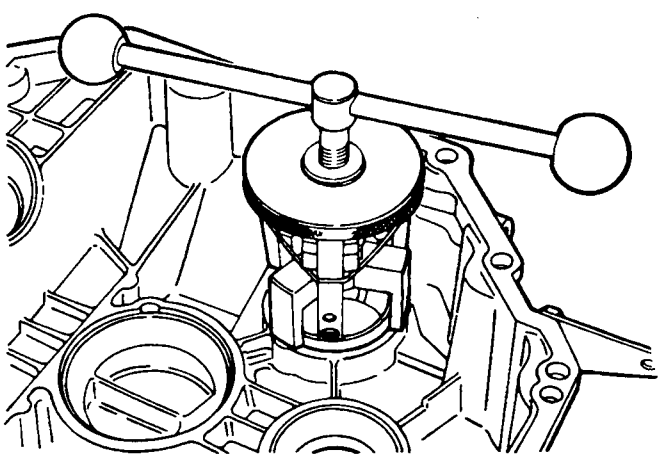
26. Pull tapered roller bearing cups from housing use special puller as follows:
    a. Position appropriate puller guide (large diameter or small diameter) over cup as shown.



27681

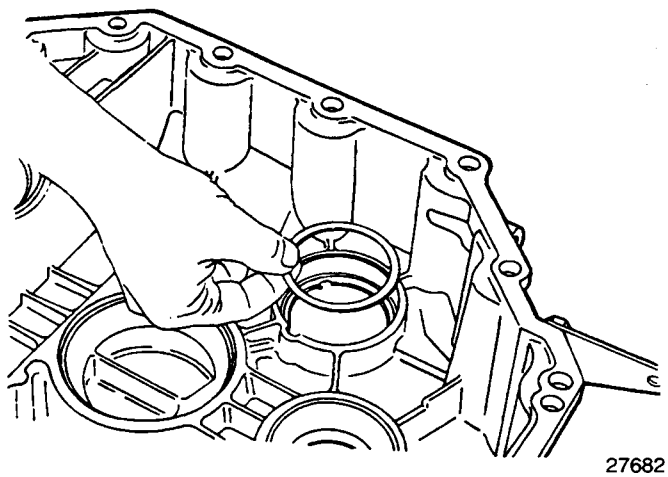
a - Small Diameter Puller Guide

    b. Pull bearing cup from housing using tool as shown.



27681

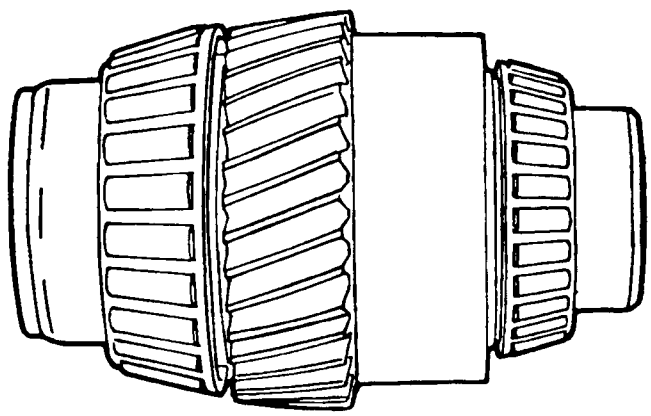
    c. **Input Housing Side:** Remove and retain shims. DO NOT MIX UP.



27682

TAPERED ROLLER BEARINGS

IMPORTANT: Bearings and gear on output shaft are not replaceable. Replace output shaft, gear, and bearings as a complete assembly only.



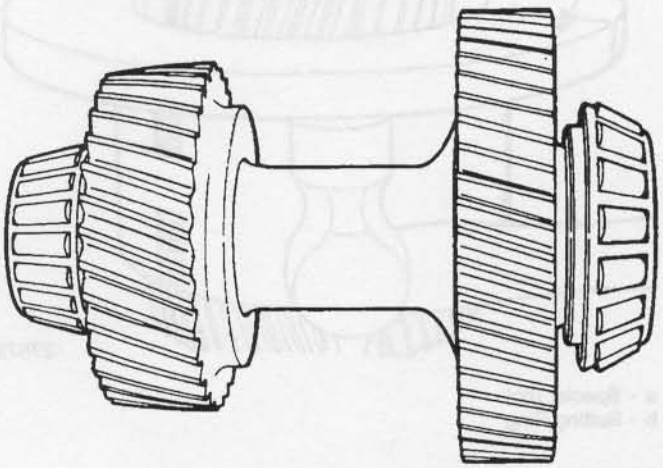
27668

⚠CAUTION

Gears should never be removed from intermediate shaft or reversing shaft, as this will affect proper gear alignment.

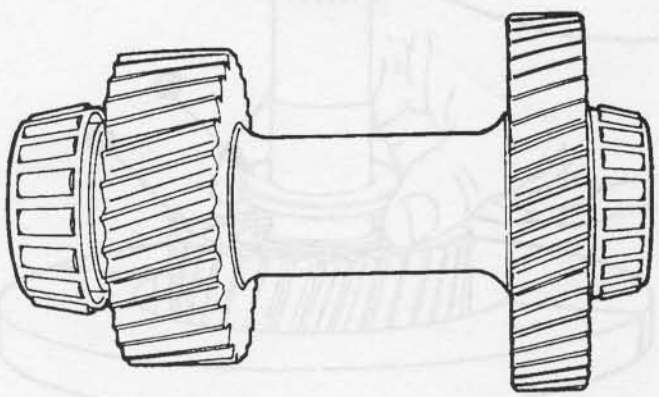
27. Remove tapered roller bearings from intermediate shaft or reversing shaft by using a universal puller plate and pressing bearings off.

INTERMEDIATE SHAFT



27668

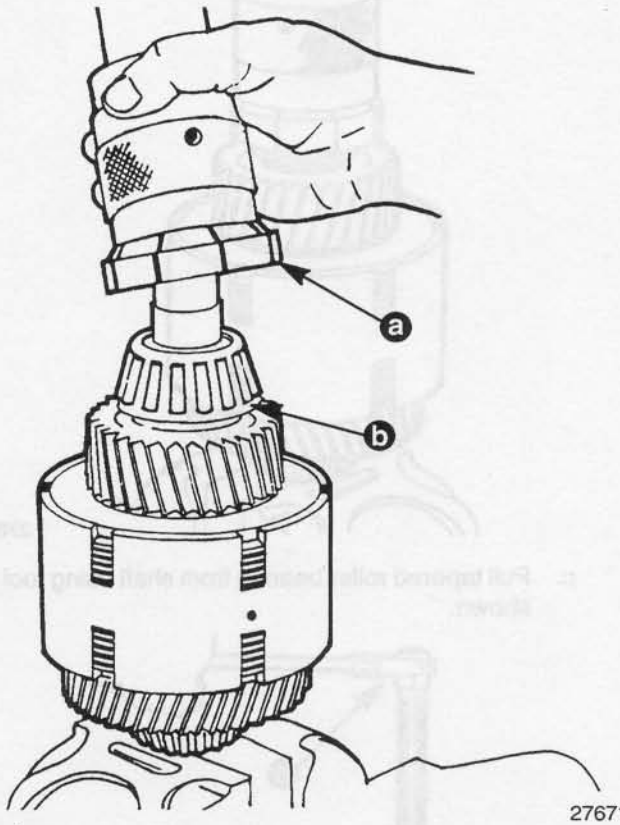
REVERSING SHAFT



27669

REVERSING CLUTCH, GEARS and TAPERED ROLLER BEARINGS

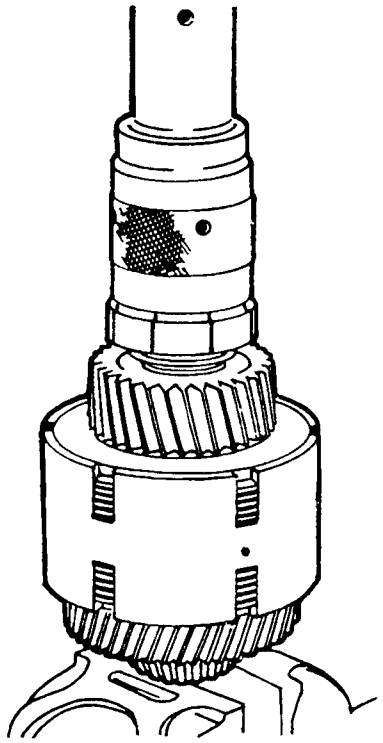
28. Remove tapered roller bearing from splined end of input shaft using special tool as follows:
    a. Place tool over tapered roller bearing. Ensure jaws of tool will be pulling on bottom edge of rollers and NOT on the cage.



27671

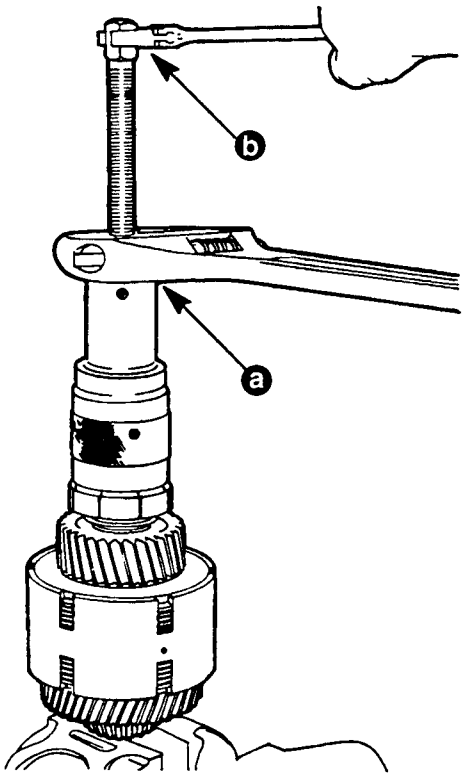
a - Jaws
b - Bottom Edge of Rollers

b. Tighten jaws onto bearing by turning on knurled part of tool. Tighten assembly.



27671

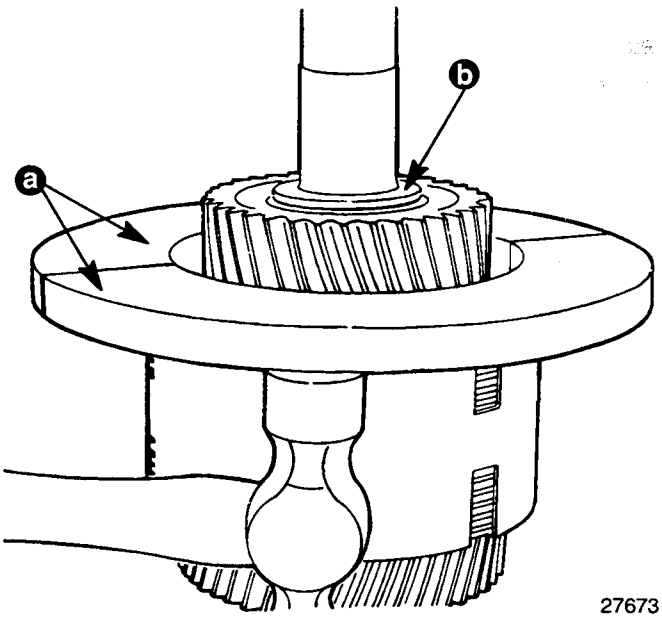
c. Pull tapered roller bearing from shaft using tool as shown.



27672

a - Hold Tool Stationary
b - Turn Top Nut

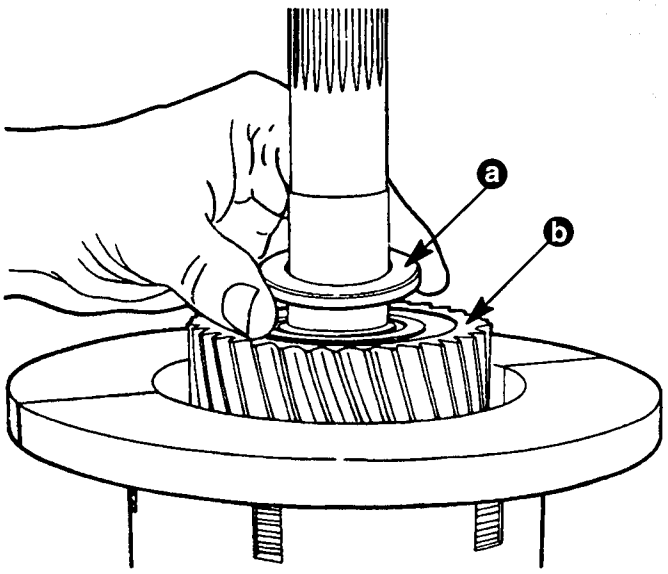
29. Remove butting ring from splined end of input shaft by installing special tool as shown and lightly tapping upward on tool.



27673

a - Special Tool
b - Butting Ring

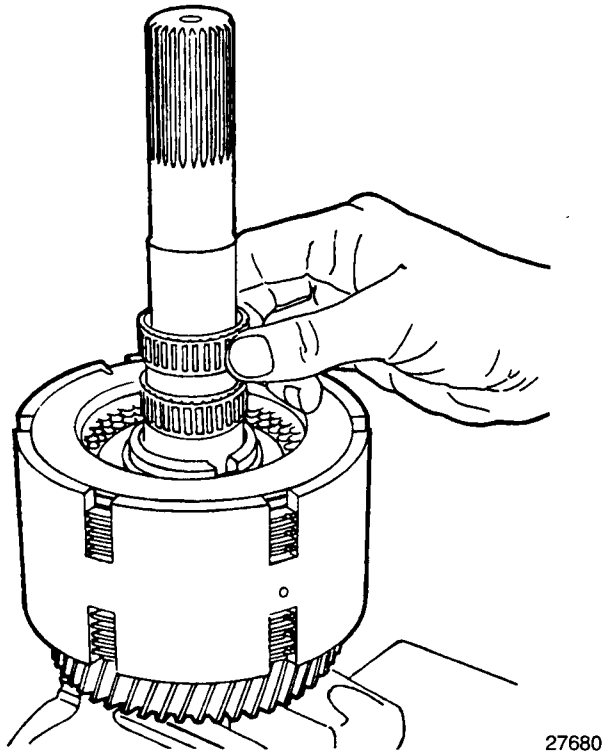
30. Remove butting ring and gear assembly.



27675

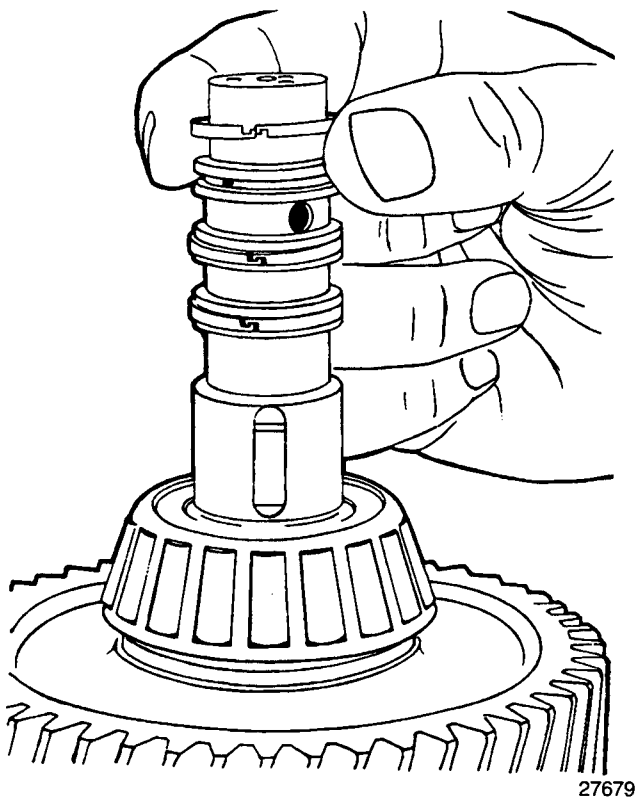
a - Butting Ring
b - Gear Assembly

31. Remove needle bearings.



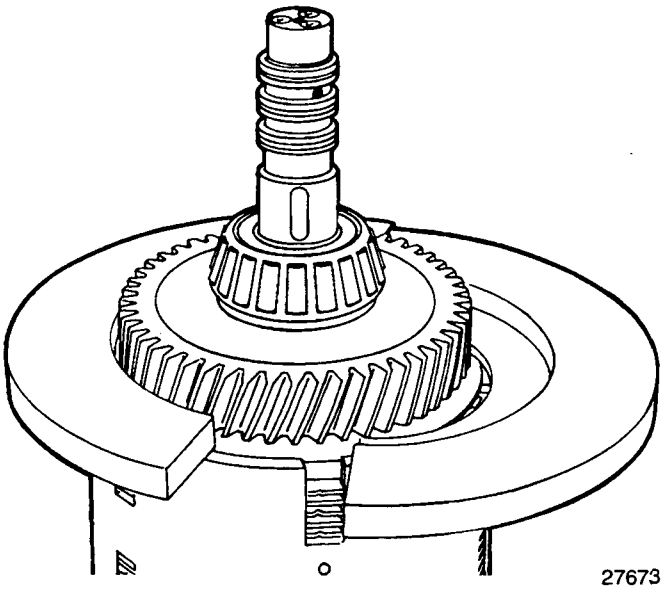
27680

32. Remove piston rings from shaft.



27679

33. Remove tapered roller bearing, butting ring and gear from piston end of shaft using special tool as shown. Press all components off at the same time. Then, remove needle bearings.

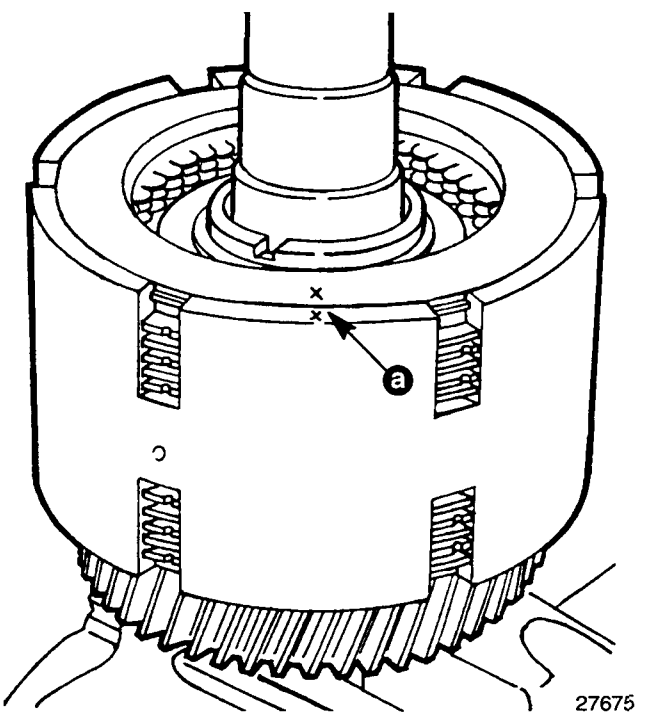


27673

CLUTCH DISCS

NOTE: Discs on both sides of clutch are removed in the same manner.

IMPORTANT: Reference marks are placed on the clutch housing and end disc to aid in locating the snap ring opening.



27675

a - Reference Marks

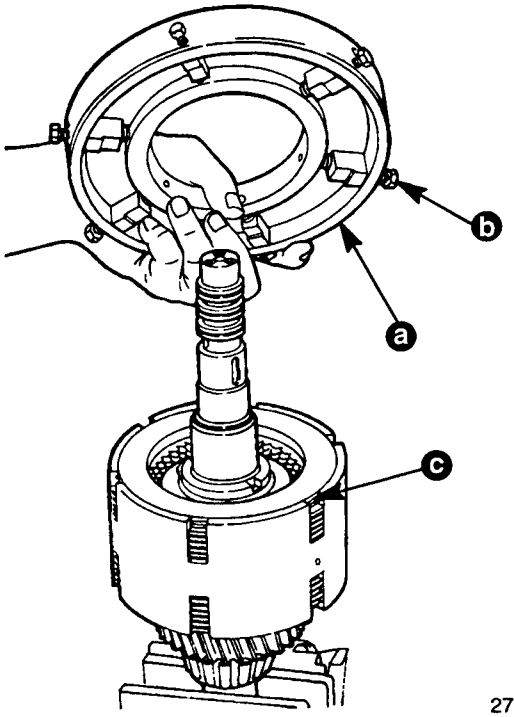
34. Position snap ring compression tool on clutch assembly so that compression screws are centered over slots in clutch housing.

35. Remove end disc and snap ring as follows:

    a. Tighten all compression screws until a slight resistance is felt.

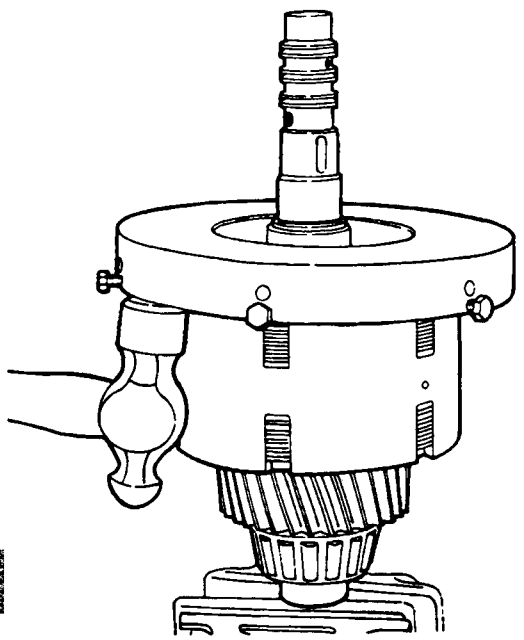
    b. Tighten compression screws evenly (approximately 1/2 turn at a time).

    c. Tap up lightly on bottom edge of compression tool until snap ring pops up and out of groove in clutch housing.



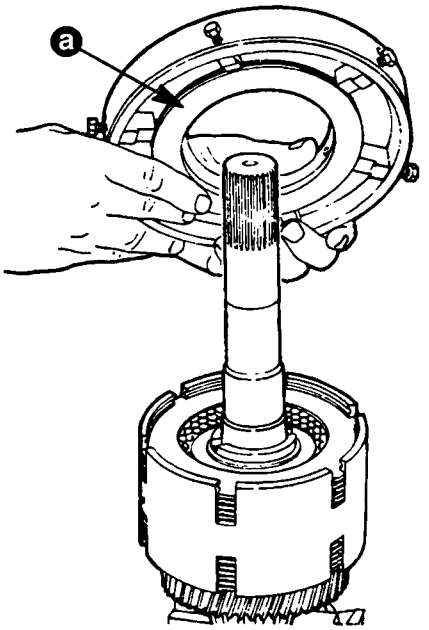
27674

a - Snap Ring Compression Tool
b - Compression Screws (6)
c - Slots



27675

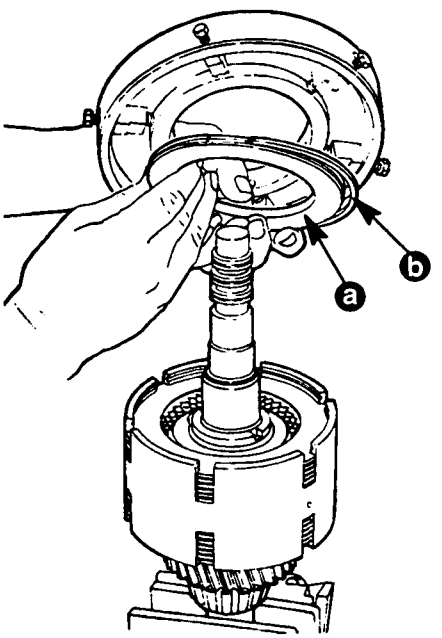
NOTE: For ease of reassembly, end disc and snap ring should not be removed from tool unless their condition is questionable.



27676

a - End Disc (Snap Ring Compressed)

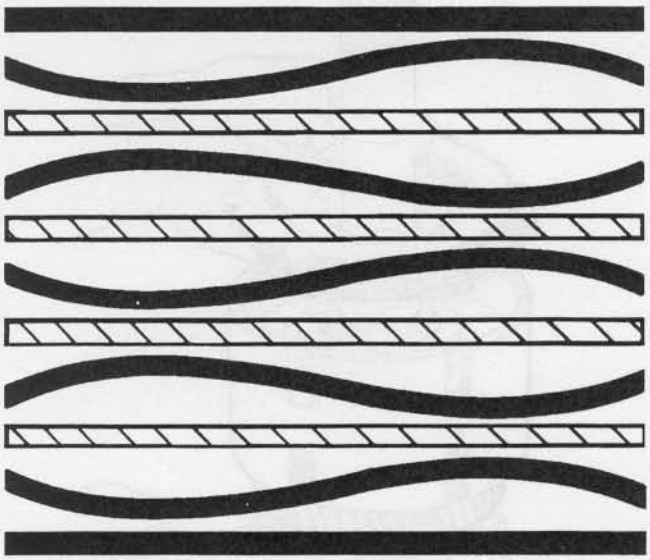
    d. If necessary, remove end disc and snap ring from tool.



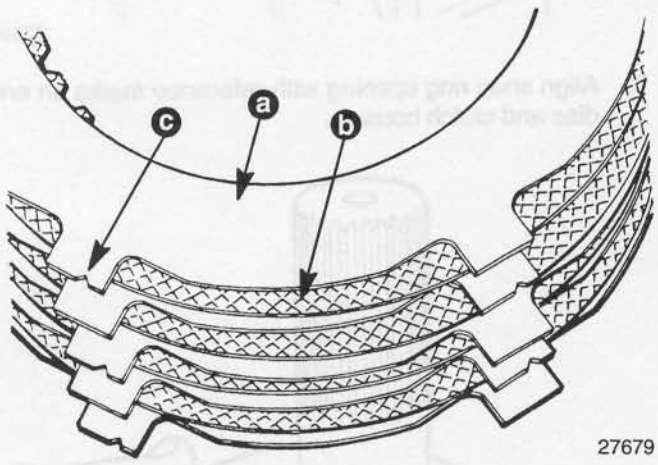
27676

a - End Disc
b - Snap Ring

IMPORTANT: Thrust discs have a wave pattern. These discs must be reinstalled in a specific pattern, when reassembled. Make note of notches in thrust disc tabs, and how they are arranged.



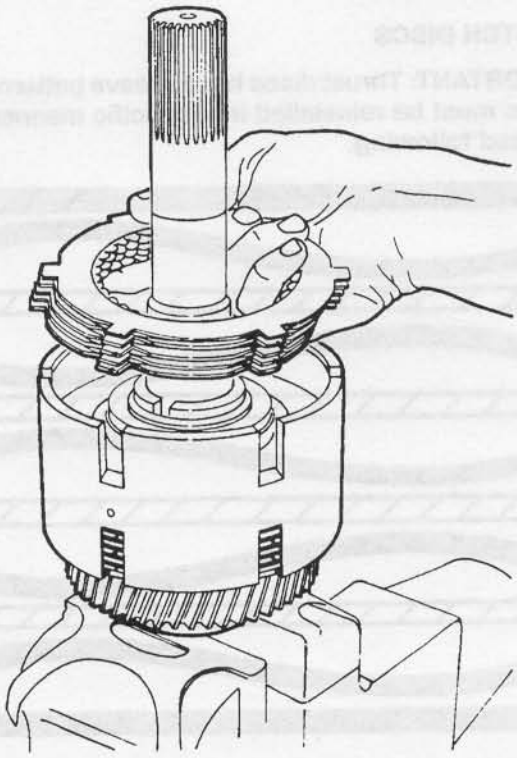
50248



27679

a - Thrust Discs (5)
b - Inner Discs (4)
c - Notches

36. Remove discs.



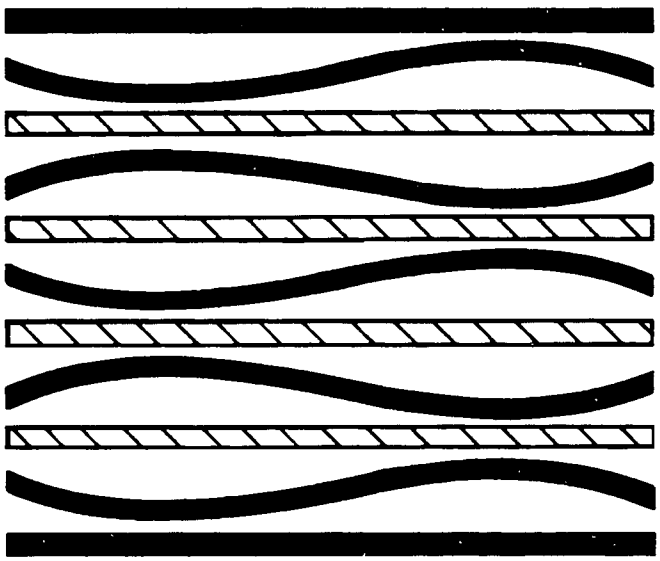
27680

37. Inspect thrust discs and inner discs for wear. Replace if there is any questionable wear.
38. Remove and inspect disc on opposite side of clutch in same manner.

Reassembly

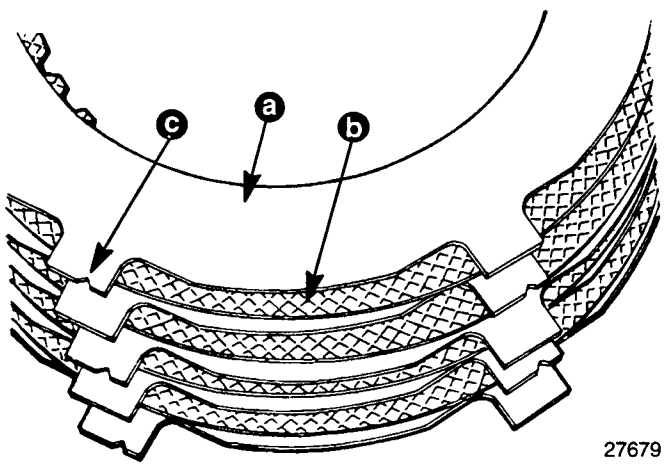
CLUTCH DISCS

IMPORTANT: Thrust discs have a wave pattern. These discs must be reinstalled in a specific manner as explained following.



50248

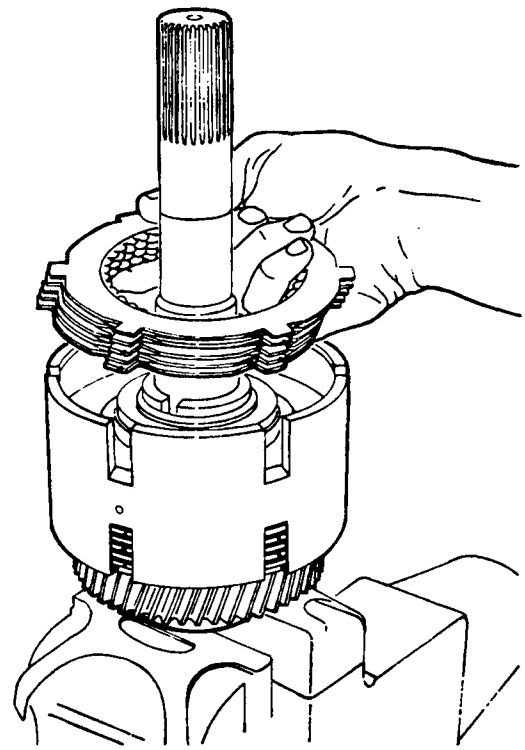
1. Arrange thrust discs and inner discs as shown. Ensure notches on thrust disc tabs are aligned as shown.



27679

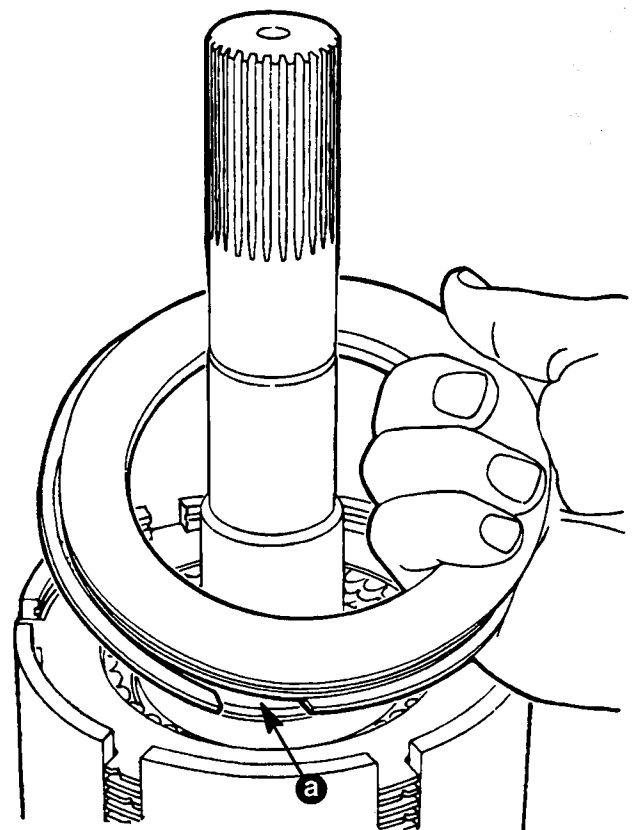
a - Thrust Discs (5)
b - Inner Discs (4)
c - Notches

2. Install discs in clutch housing.



27680

3. Align snap ring opening with reference marks on end disc and clutch housing.

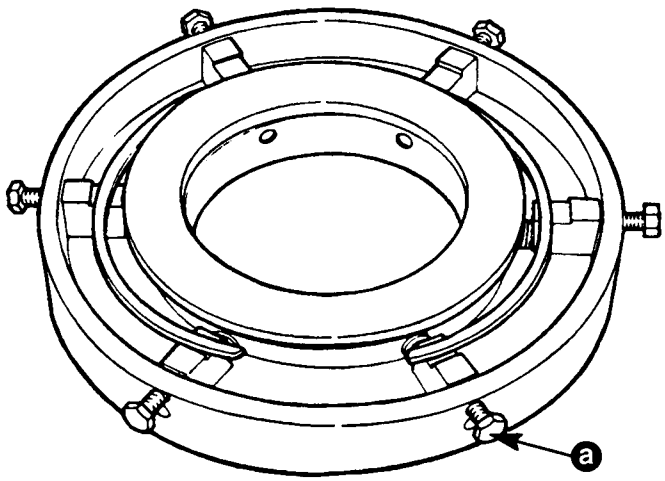


27678

a - Snap Ring Opening

4. If end disc and snap ring were removed from tool, reinstall as follows:

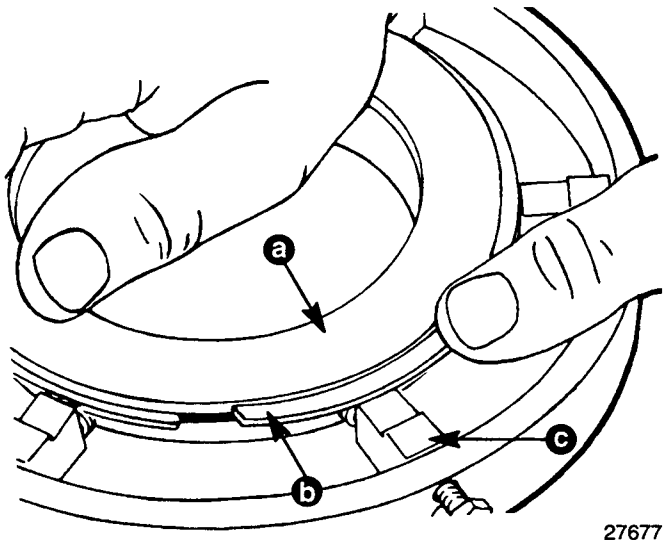
   a. Loosen all compression screws on tool.



27677

a - Compression Screws

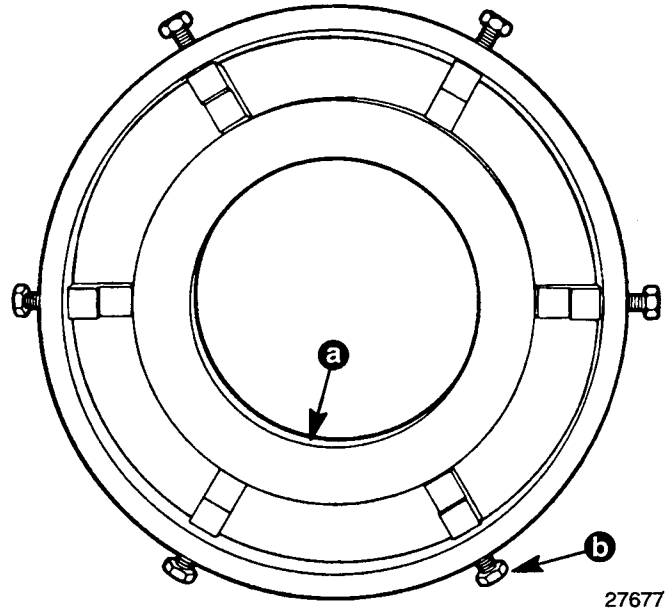
   b. Place snap ring into groove in end disc and compress by hand so that compression dogs will hold in on snap ring.



27677

a - End Disc
b - Snap Ring
c - Compression Dogs

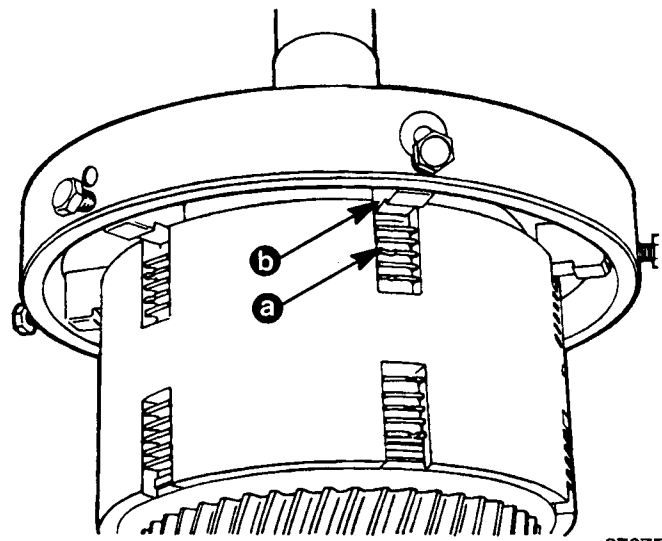
   c. Tighten compression screws evenly to completely compress snap ring into end disc.



27677

a - End Disc
b - Compression Screws

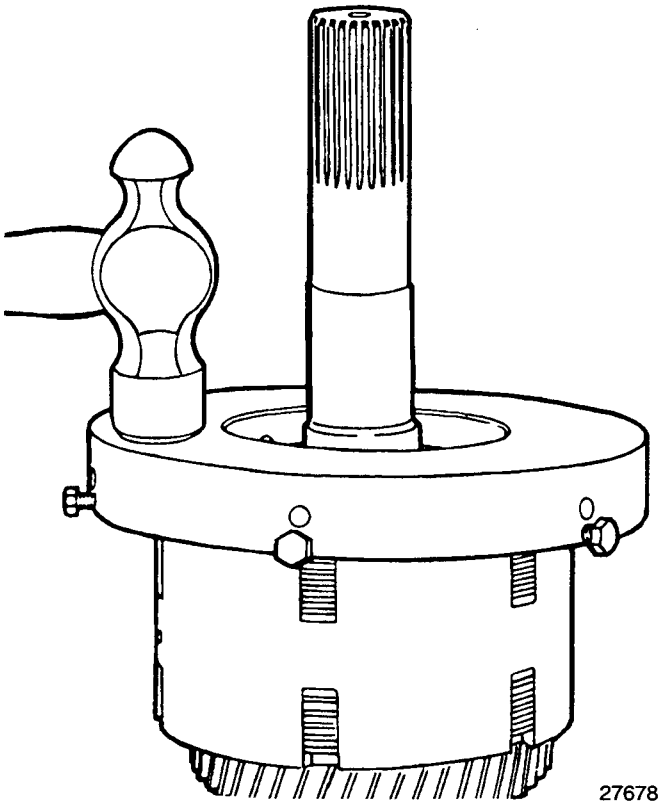
   d. Carefully lower end disc and special tool onto clutch housing and align compression dogs with slots in housing.



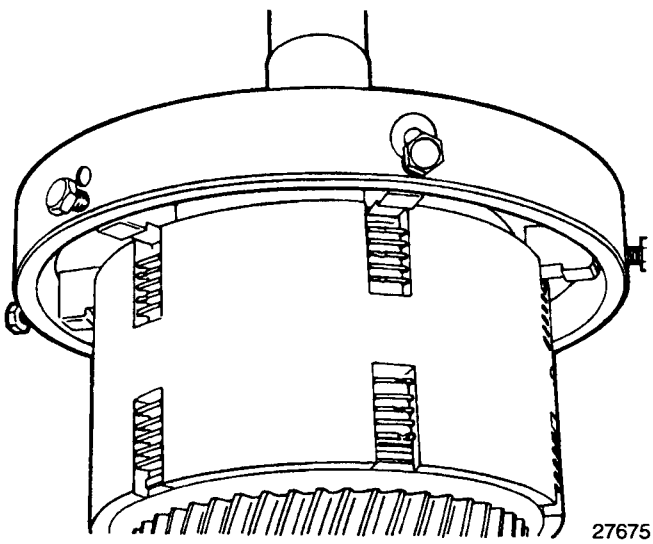
27675

a - Slots
b - Compression Dogs

5. Tap lightly around top of tool until end disc bottoms. Loosen compression screws and remove tool.

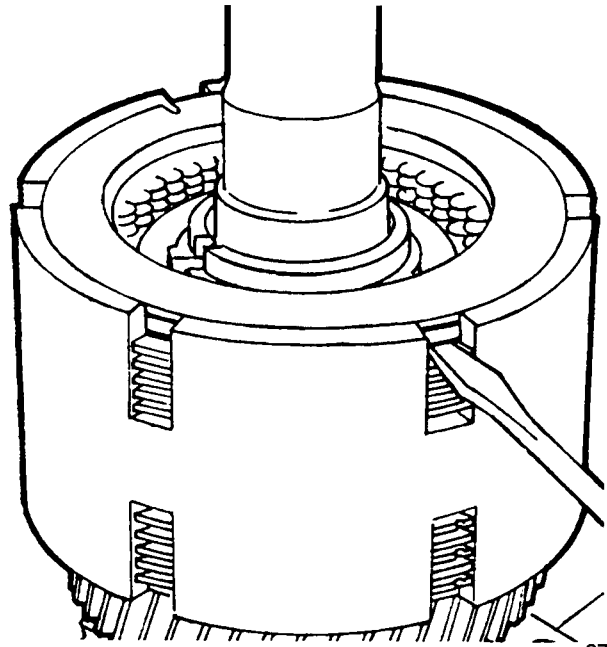


27678



27675

6. Double check that snap ring has been properly seated by prying up lightly on end disc.

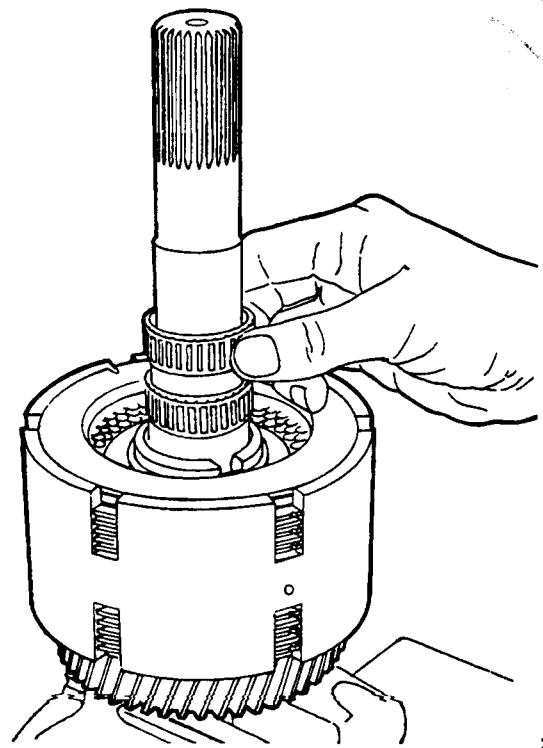


27679

7. Reinstall discs on opposite side of clutch in same manner.

NEEDLE BEARINGS

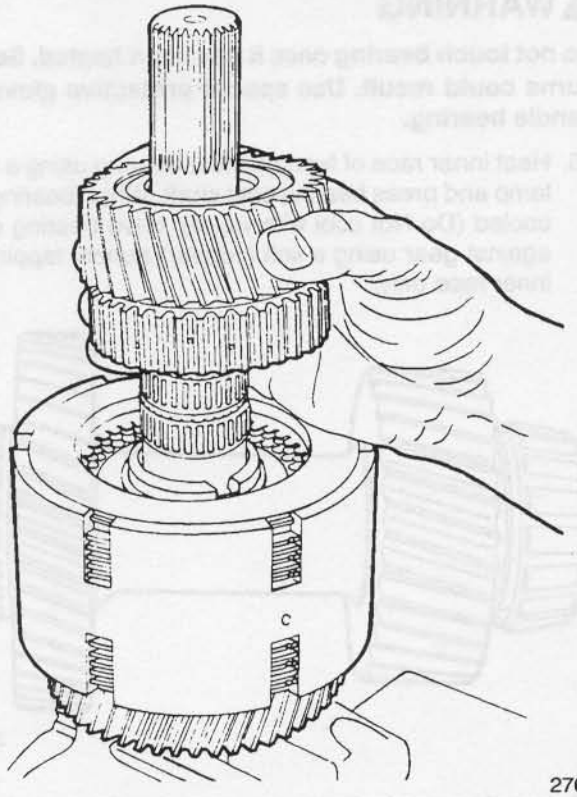
8. Reinstall needle bearings.



27680

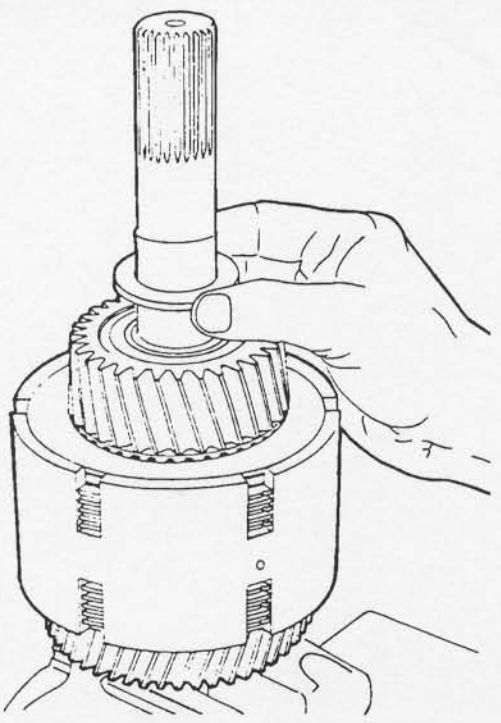
GEAR ASSEMBLY

9. Reinstall gear assembly. Twist gear assembly from side to side to allow splines to engage with inner discs. Ensure all inner discs are engaged with splines by observing through slots in clutch housing.



27673

10. Reinstall butting ring.



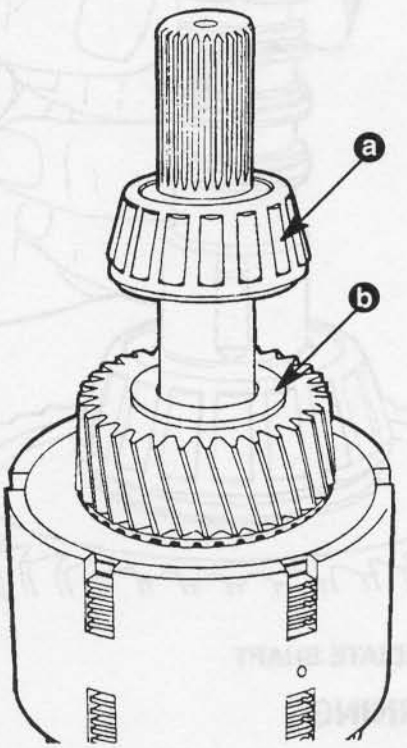
27672

TAPERED ROLLER BEARING

⚠CAUTION

Do not touch bearing once it has been heated. Severe burns could result. Use special protective gloves to handle bearing.

11. Heat inner race of tapered roller bearing using a torch lamp and press bearing onto shaft. When bearing has cooled down (Do Not cool with water), tap bearing **carefully** down to ensure proper seating against butting ring, using a soft (copper) punch **tap on inner race only.**



27674

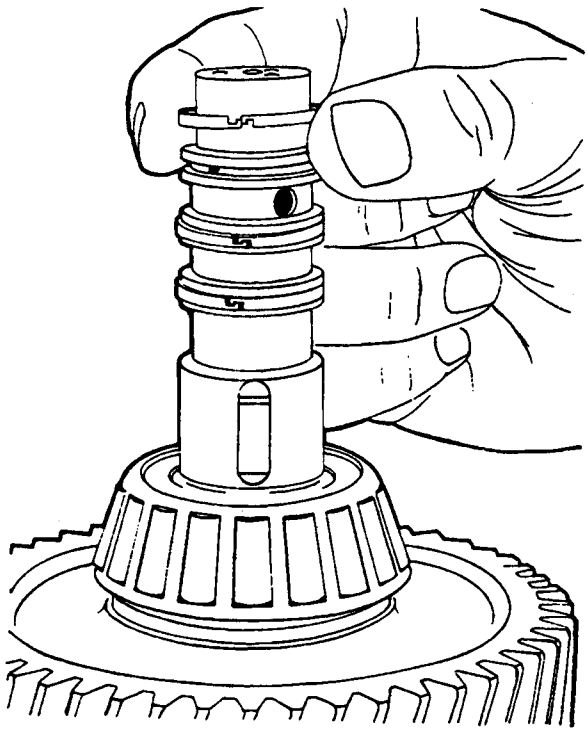
a - Tapered Roller Bearing
b - Butting Ring

12. Install components on opposite side of clutch assembly in same manner.

⚠CAUTION

Use care in reinstalling piston rings on input shaft. Piston rings are brittle and may snap if spread too far open.

13. Reinstall piston rings on input shaft. Ensure ends of rings are coupled as shown. Then, position rings so that ends are staggered so no two are aligned.



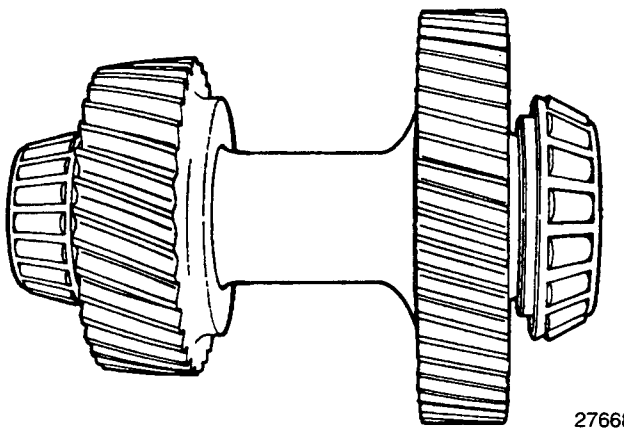
27679

INTERMEDIATE SHAFT

⚠WARNING

Do not touch bearing once it has been heated. Severe burns could result. Use special protective gloves to handle bearing.

14. Heat inner race of tapered roller bearing using a torch lamp and press bearing onto shaft. When bearing has cooled down (Do Not cool with water), tap bearing **carefully** down to ensure proper seating against gear, using a soft (copper) punch. **Tap on inner race only.**



27668

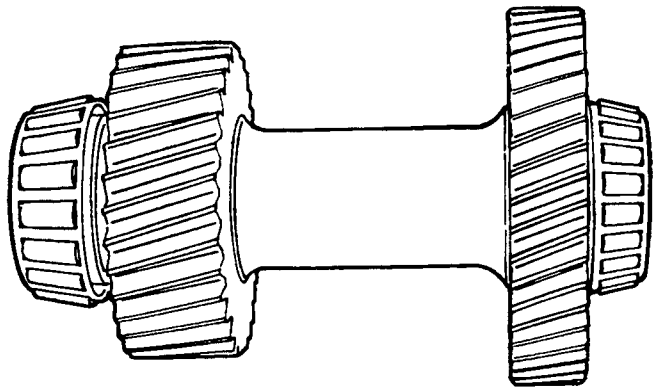
15. Install tapered roller bearing on opposite end of shaft in the same manner.

REVERSING SHAFT

⚠WARNING

Do not touch bearing once it has been heated. Severe burns could result. Use special protective gloves to handle bearing.

16. Heat inner race of tapered roller bearing using a torch lamp and press bearing onto shaft. When bearing has cooled (Do Not cool with water), drive bearing down against gear using a soft (copper) punch, tapping on inner race only.



27669

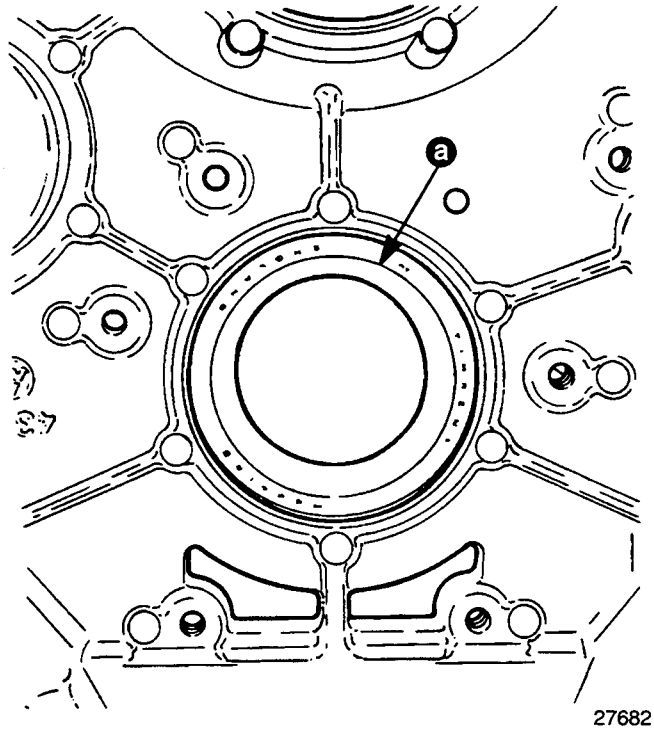
17. Install tapered roller bearing on opposite end of shaft in the same manner.

Preassembly of Output Half of Housing

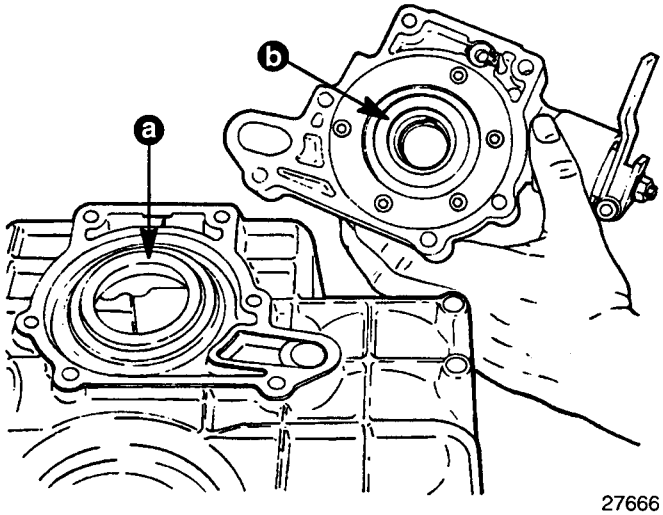
IMPORTANT: If tapered roller bearing cups were removed, ensure output shaft seal IS NOT in place, as it will be necessary to heat housing prior to installing bearing cups.

IMPORTANT: The tapered roller bearing cup on the input shaft (control block end) is properly positioned by bottoming out on the face of the control block assembly. It will be necessary to temporarily install control block to install this tapered roller bearing cup.

18. Temporarily install control block on outer housing. Tighten bolts securely.



27682



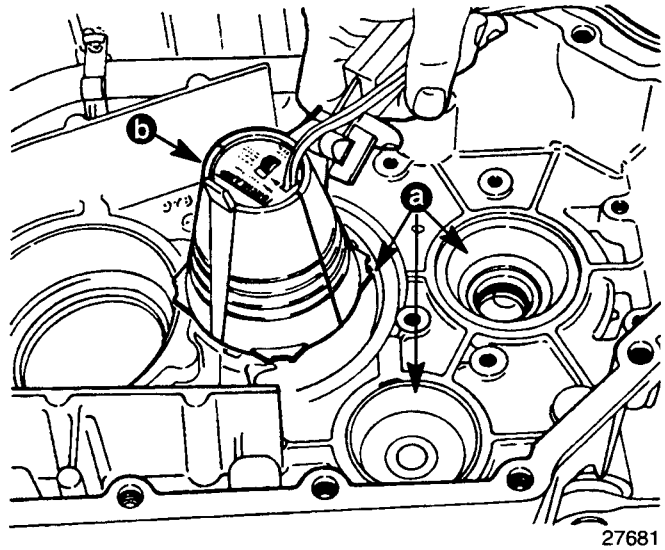
27666

a - Input Shaft Bearing Cup
b - Control Block Face

⚠ WARNING

Use care in handling housing, once it is heated with torch lamp. Severe burns could result. Use special protective gloves when handling housing.

19. Heat bearing bores of housing using a torch lamp and install bearing cups using a suitable mandrel.



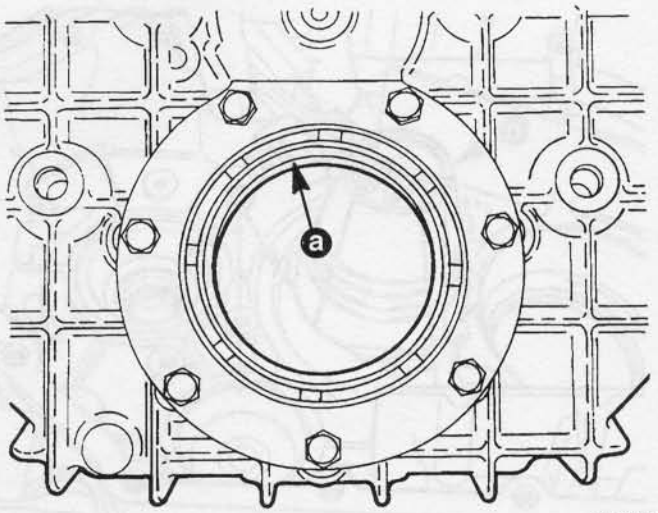
27681

a - Bearing Cups
b - Torch Lamp

20. Allow housing to cool (Do Not cool with water) and then tap bearing cup with suitable mandrel to ensure it is properly seated.
21. Remove control block assembly.

OUTPUT SHAFT SEAL

22. **If bearings were not replaced and no shimming is required,** push new seal onto special mandrel. Ensure seal will be positioned with lip of seal facing inward. Drive seal uniformly into bore of housing to the point that it is countersunk .040 in. (1mm) with reference to housing surface.

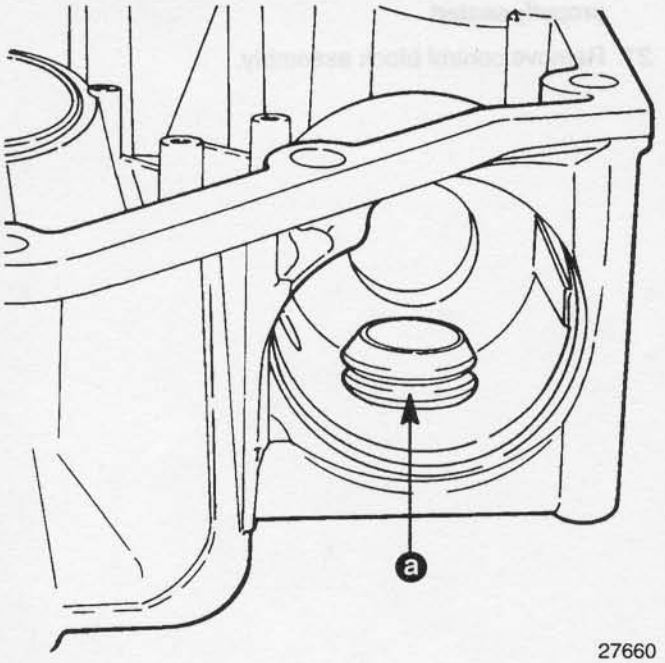


27669

a - Seal

SUCTION PIPE

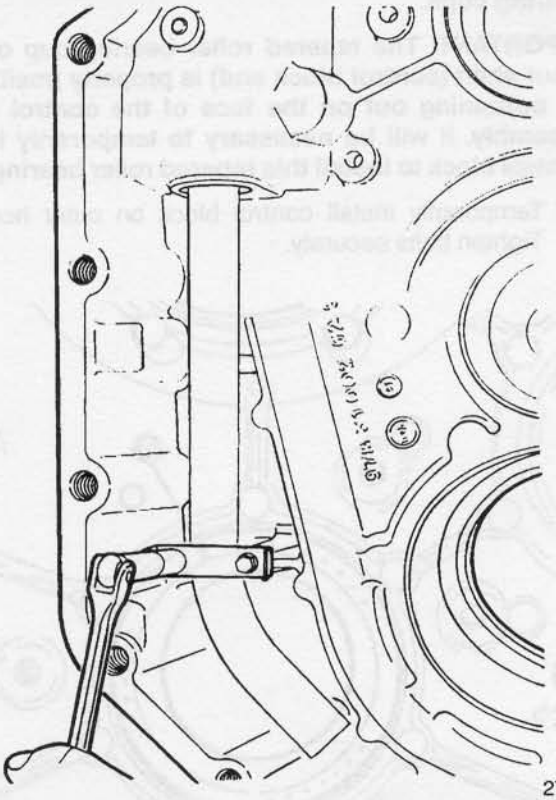
23. Reinstall suction pipe seal in bottom of oil filter bore. Coat seal with ATF.



27660

a - Seal

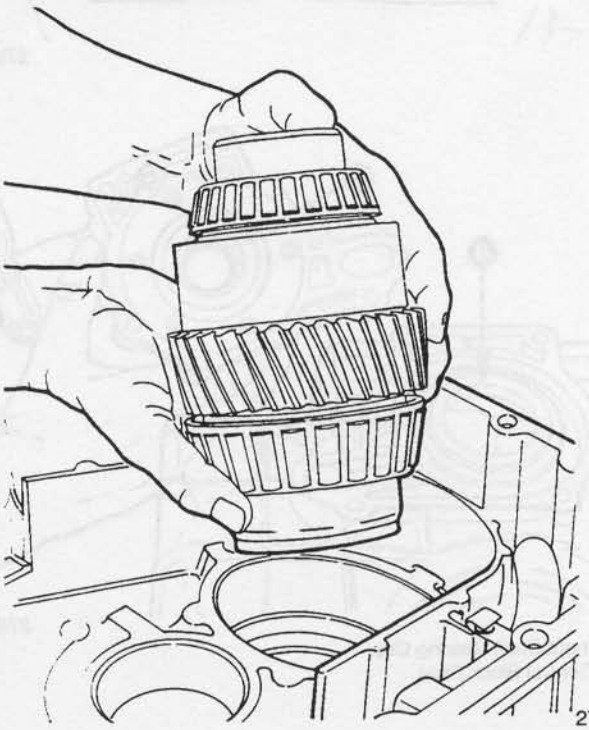
24. Reinstall suction pipe. Place one drop of Loctite Type "A" on screw threads. Then, secure suction pipe down with retainer plate. Tighten screws securely.
25. Bend tabs down over screws.



27665

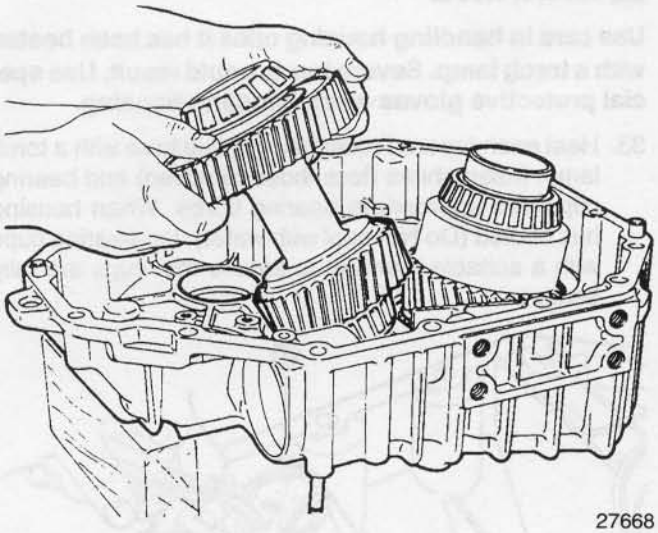
SHAFTS

26. Coat tapered roller bearings with ATF.
27. Install output shaft.



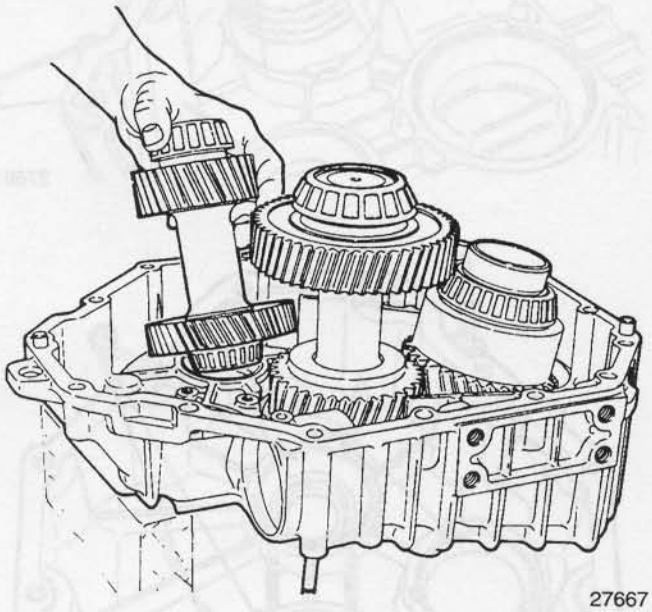
27668

28. Install reversing shaft.



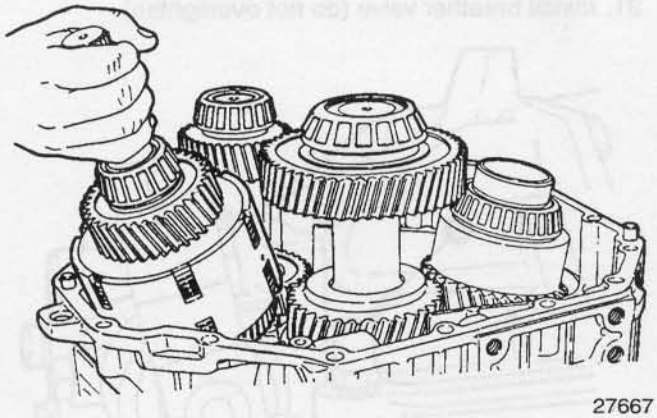
27668

29. Install intermediate shaft.

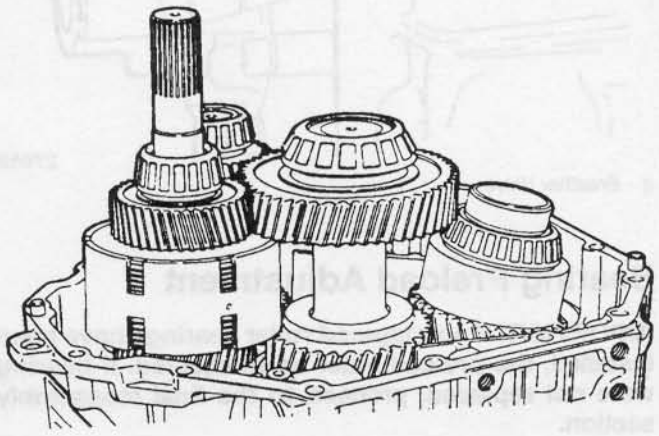


27667

30. Install input shaft. Ensure all gears mesh as shown.



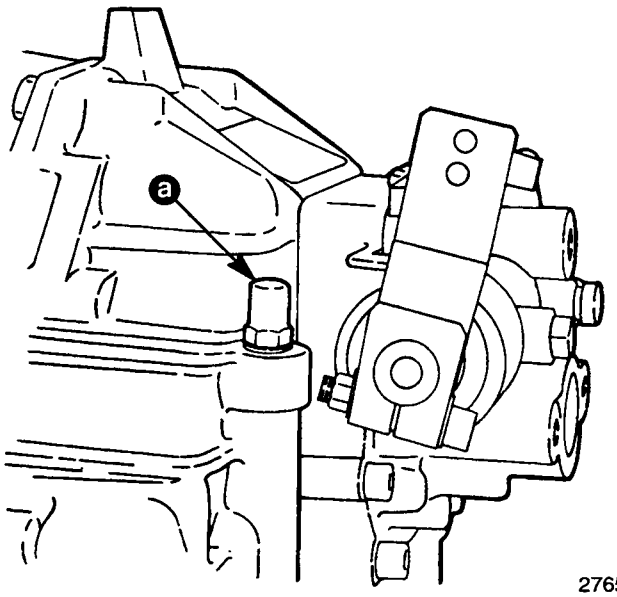
27667



27667

Preassembly of Input Half of Housing

31. Install breather valve (do not overtighten).



27659

a - Breather Valve

Bearing Preload Adjustment

IMPORTANT: If new tapered roller bearings have been installed, the preload must be readjusted. If bearing were not replaced, proceed to the final reassembly section.

NOTE: The required preload of bearings of the individual shafts is obtained by using shims beneath the tapered roller bearing cups in the input half of the housing.

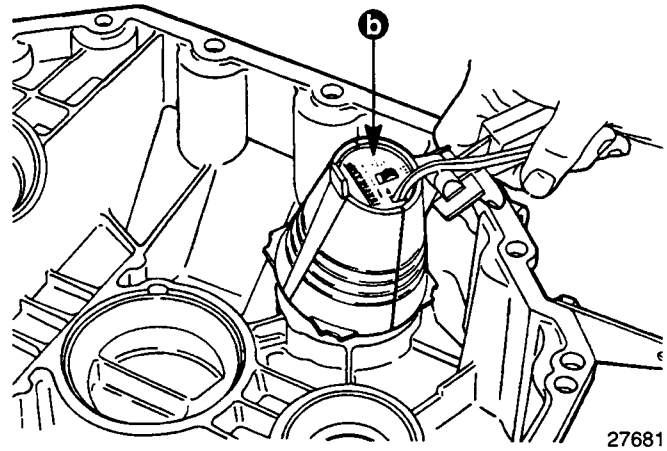
NOTE: Shims which have been removed during disassembly may be reused.

32. Subtract approximately .008 in. (.2mm) of shims from each bearing cup bore. Remove and set aside, but do not mix up.

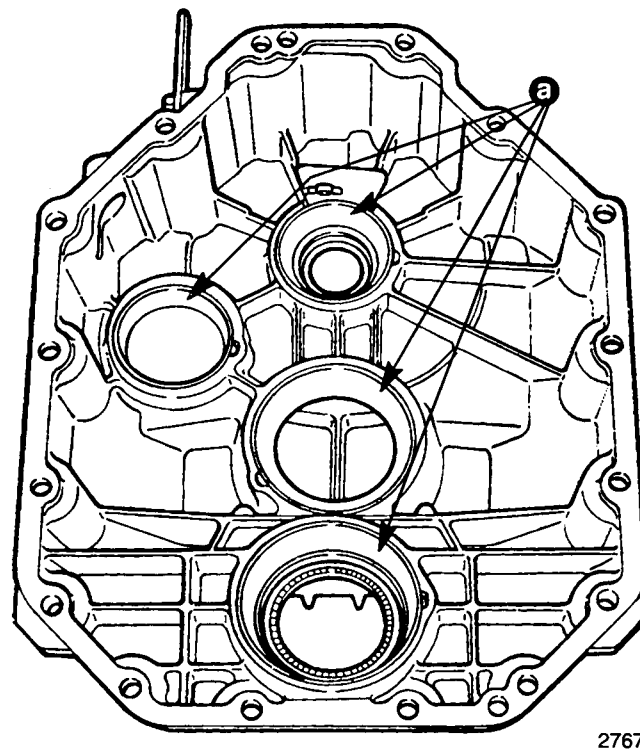
⚠ WARNING

Use care in handling housing once it has been heated with a torch lamp. Severe burns could result. Use special protective gloves when handling housing.

33. Heat each tapered roller bearing cup bore with a torch lamp. Insert shims (less those removed) and bearing cups into appropriate bearing bores. When housing has cooled (Do Not cool with water), tap bearing cups with a suitable mandrel to ensure that cups are fully seated.



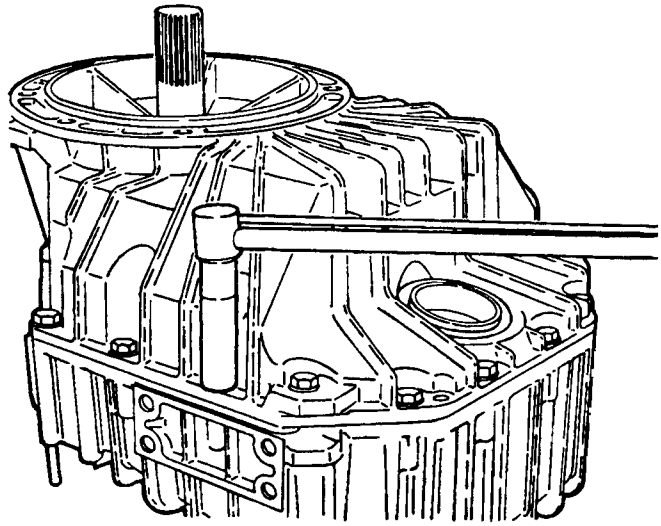
27681



27670

a - Bearing Cups
b - Torch Lamp

34. Install input half of housing onto output half. Ensure locator pins are in place. Install bolts and lockwashers and torque to 36 lb. ft. (49 N·m).

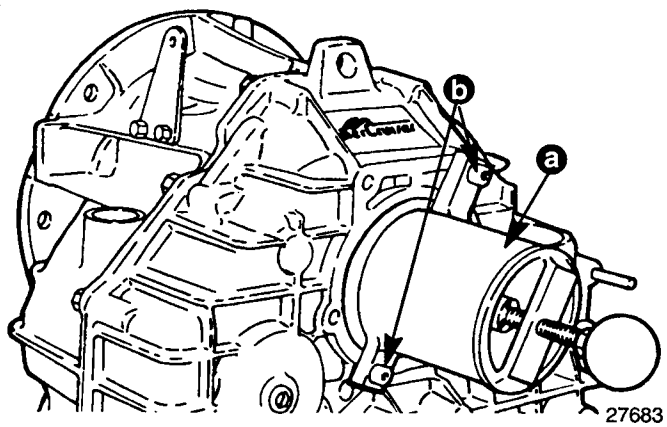


27661

INPUT SHAFT PRELOAD

35. Measure bearing clearance as follows:

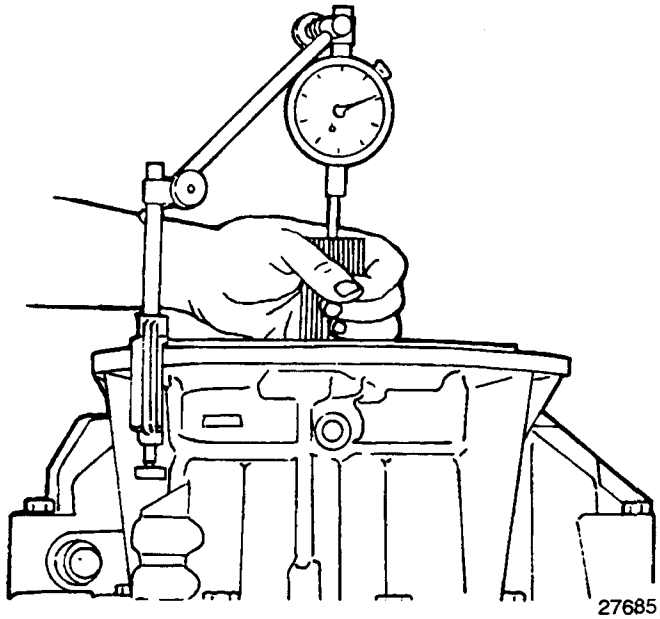
    a. Install special tool as shown. Tighten hold down bolts securely.



27683

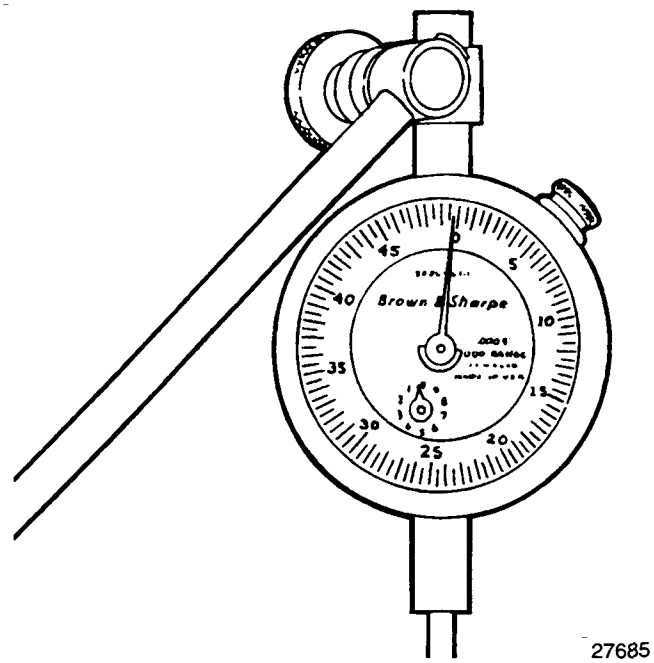
a - Special Tool
b - Hold Down Bolts

    b. Mount dial indicator on input shaft. Turn input shaft several times to seat bearing.



27685

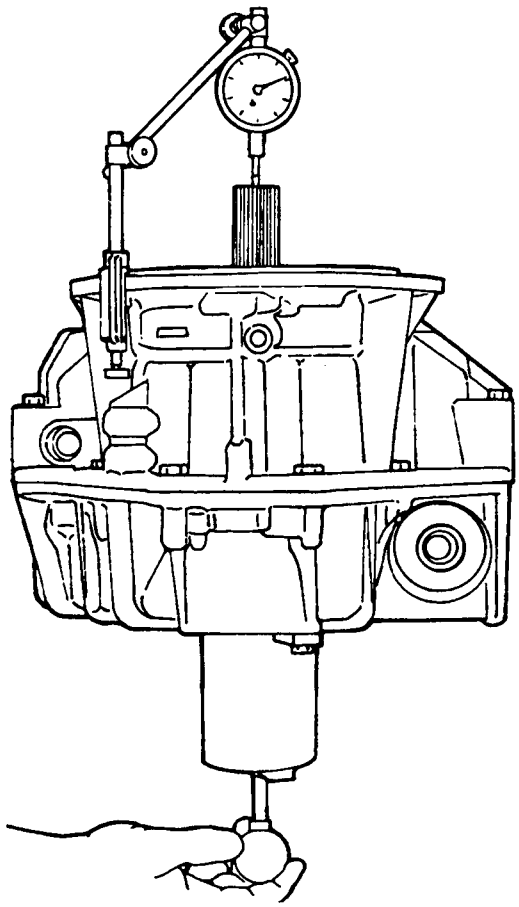
    c. Zero the dial indicator.



27685

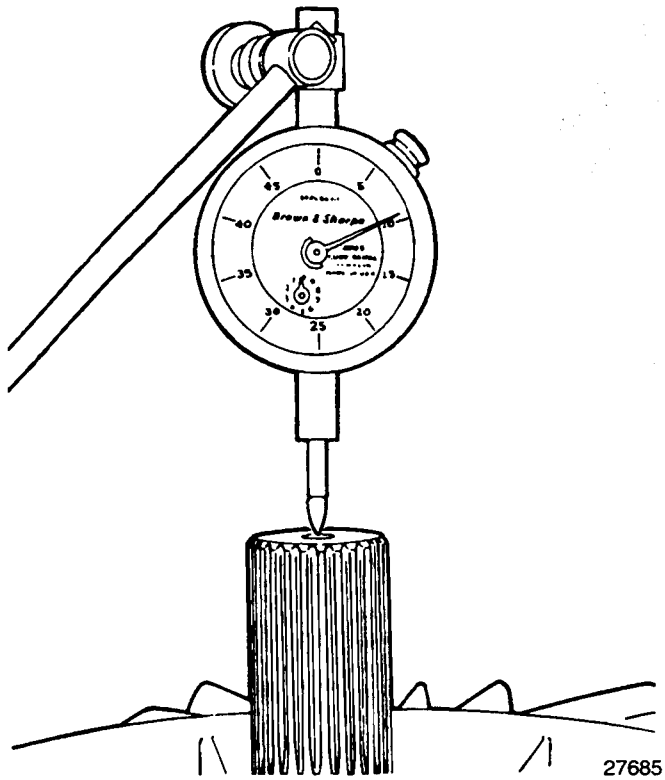
IMPORTANT: The following step should be done very carefully to obtain the actual bearing clearance. Avoid bumping the input shaft and turn very slowly on the special tool knob. (Shaft will only be moving a very small amount.)

d. Slowly turn the special tool knob clockwise to push the shaft upward. (Perform the above sequence several times to ensure on accurate reading.)



27682

e. Make note of reading. The bearing clearance measured **PLUS** the preload required is equal to the amount of shim thickness to be **ADDED.**



27685

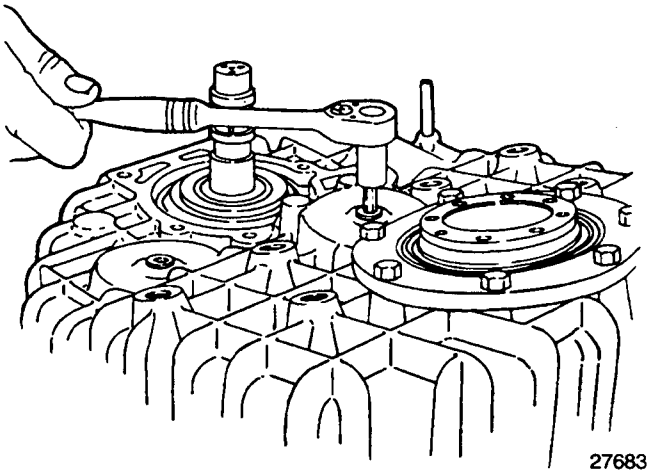
Example:

	Bearing Clearances Measured	.009 in.
+	Bearing Preload Required	.004 in.
=	Shims to Be Added	.013 in.

INTERMEDIATE SHAFT PRELOAD

36. Measure bearing clearance as follows:

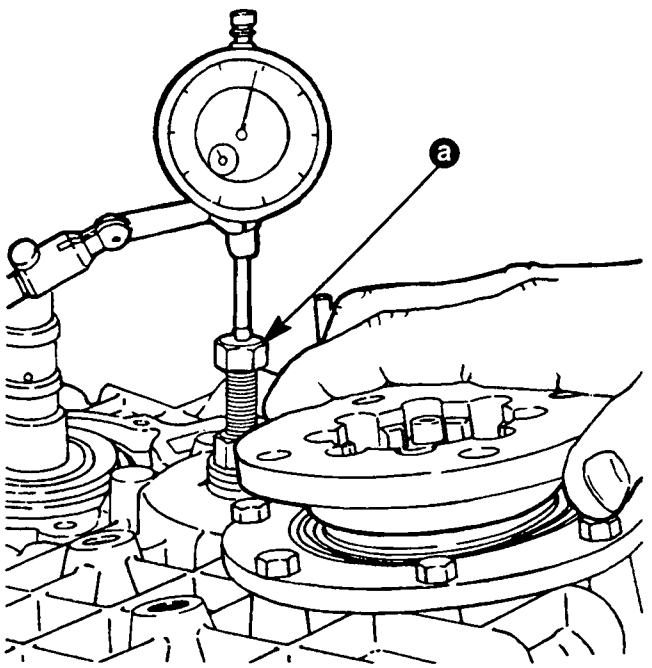
a. Remove hex plug from housing.



27683

b. Screw special bolt with nut into intermediate shaft and tighten snuggly. Turn nut up until it touches bolt head.

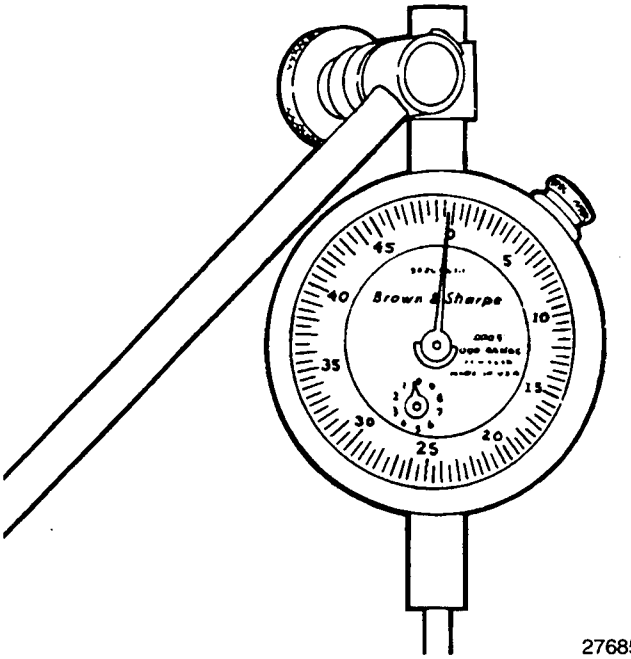
c. Mount dial indicator on bolt head. Turn output shaft several times to ensure bearing is seated.



27683

a - Special Bolt with Nut

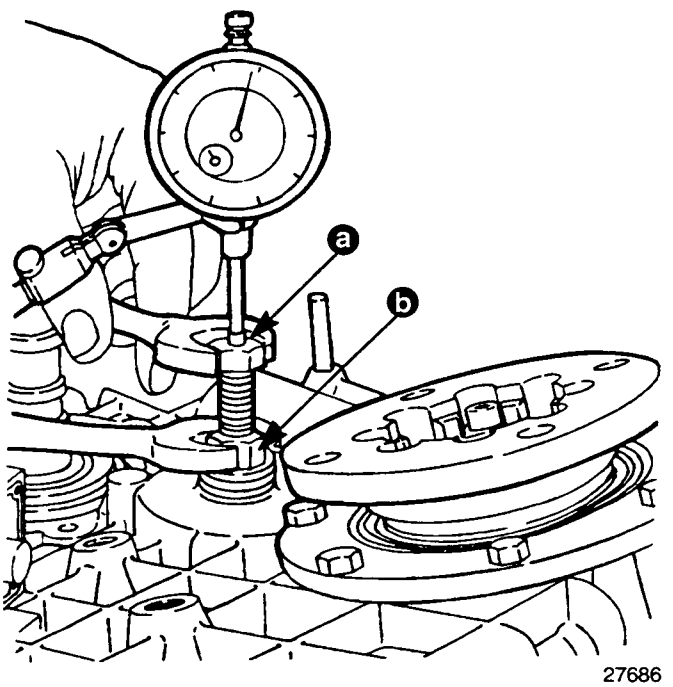
d. Zero dial indicator.



27685

IMPORTANT: The following step should be done very carefully, to obtain the actual bearing clearance. Turn nut very slowly as shaft will only be moving a small amount.

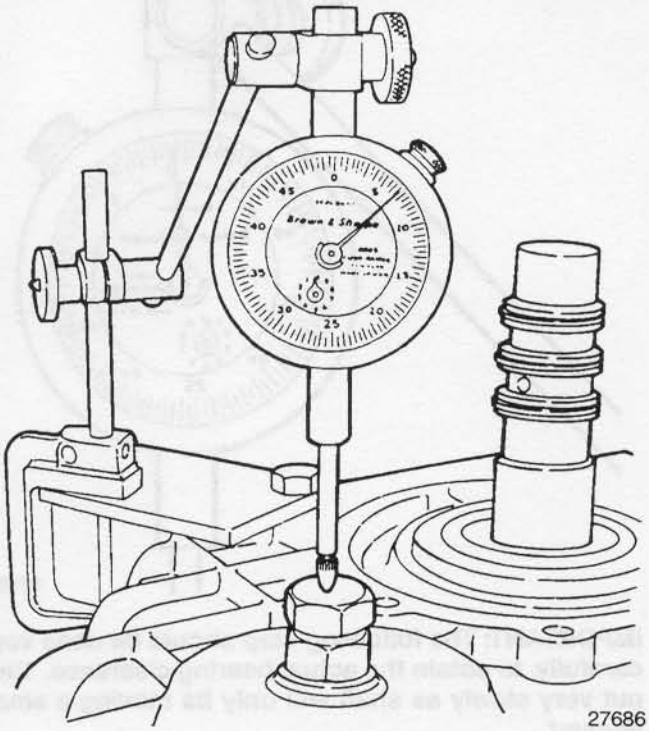
e. Hold bolt with one wrench and slowly turn down nut to pull shaft upward. (Perform the above sequence several times to ensure accurate reading.)



27686

a - Bolt - Hold Stationary
b - Nut - Turn to Move Shaft

f. Make note of the reading. The bearing clearance measured **PLUS** the preload required is equal to the amount of shim thickness to be **ADDED.**



27686

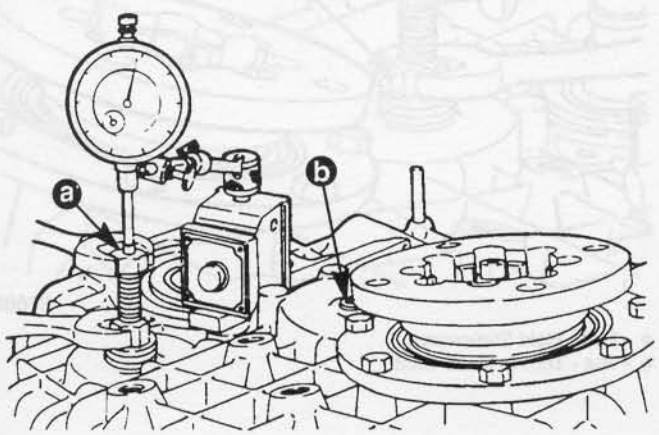
Example:

	Bearing Clearance Measured	.007 in.
+	Bearing Preload Required	.004 in.
=	Shims to Be Added	.011 in.

g. Remove dial indicator, special bolt and nut, and reinstall hex plug. Tighten securely.

REVERSING SHAFT PRELOAD

The reversing shaft preload is adjusted exactly the same as the intermediate shaft. Refer to that procedure for adjusting reversing shaft.

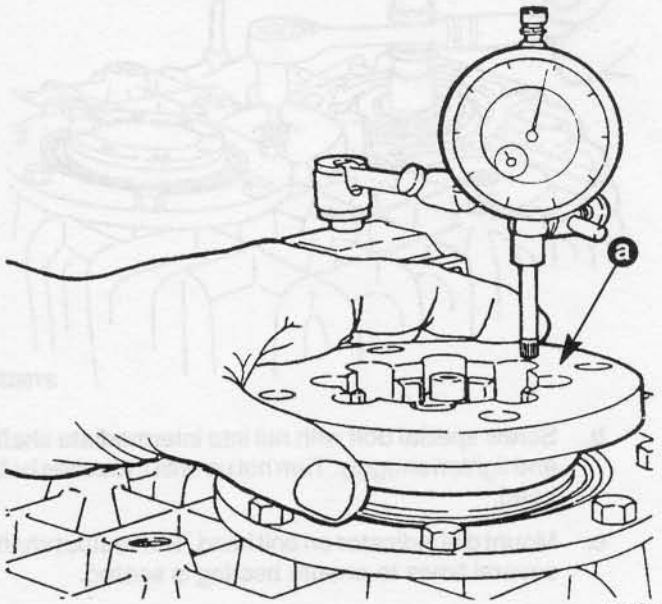


27683

a - Reversing Shaft Location
b - Intermediate Shaft Location

OUTPUT SHAFT PRELOAD

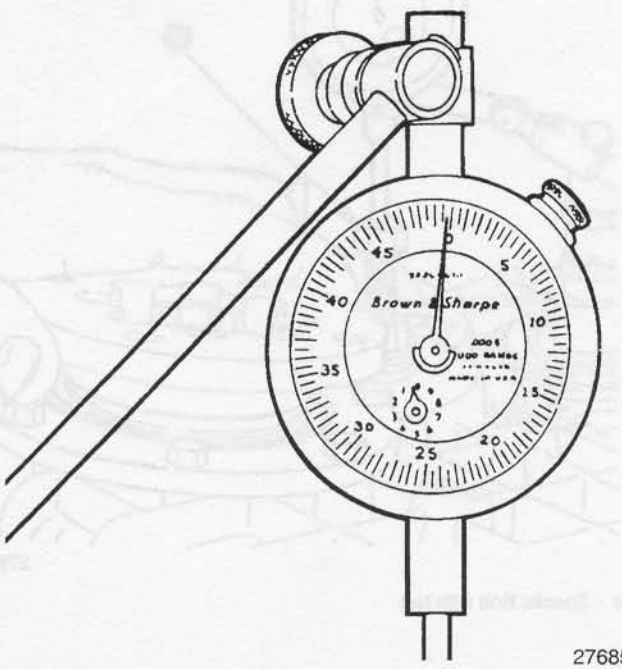
37. Measure the bearing clearance as follows:
    a. Install flange washer and bolt. Tighten snuggly.
    b. Mount dial indicator on bolt head. Turn output shaft several times to ensure bearing is seated.



27685

a - Flange

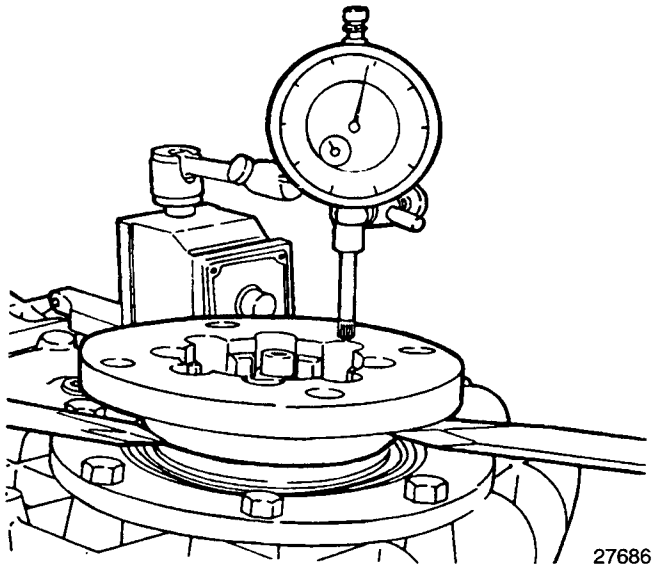
c. Zero dial indicator.



27685

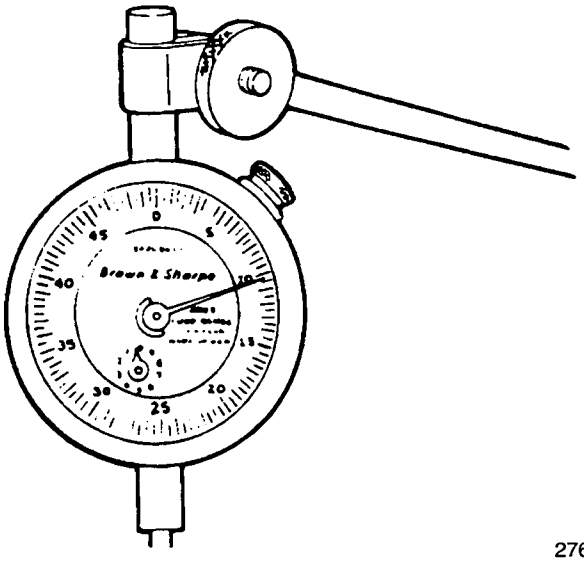
IMPORTANT: The following step should be done very carefully to obtain the actual bearing clearance. Pry up gently and evenly to lift shaft. Shaft will only move a small amount.

d. Pry up on washer to lift output shaft.



27686

e. Make note of the reading. The bearing clearance measured **PLUS** the preload required is equal to the amount of shim thickness to be **ADDED.**



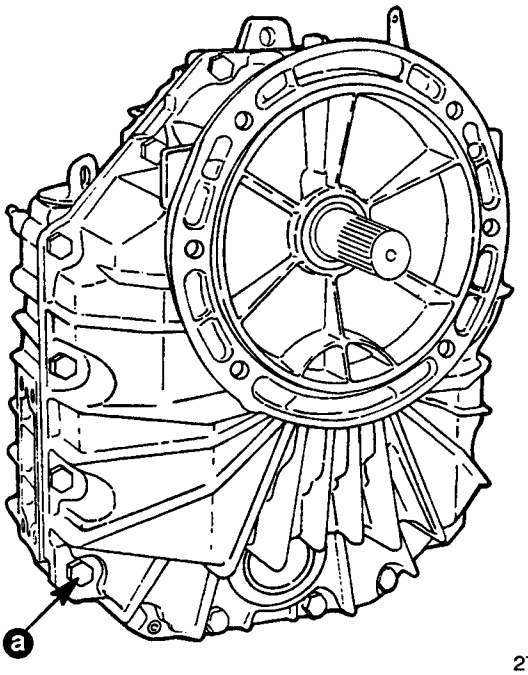
27686

Example:

	Bearing Clearance Measured	.010 in.
+	Bearing Preload Required	.004 in.
=	Shims to Be Added	.014 in.

f. Remove dial indicator.

38. When thickness of shims to be **ADDED** has been determined, the input half of housing must again be removed. Remove bolts and lockwashers, then lift off input half of housing.

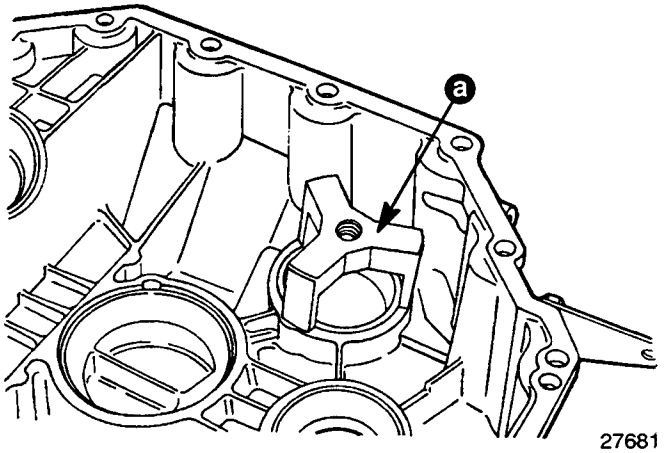


27659

a - Bolts (16)

39. Remove tapered roller bearing cups from housing using special puller as follows:

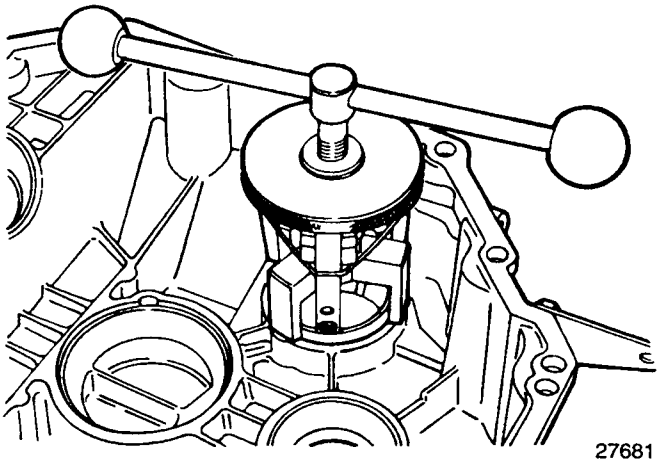
a. Position appropriate puller guide (large or small diameter) over cup as shown.



27681

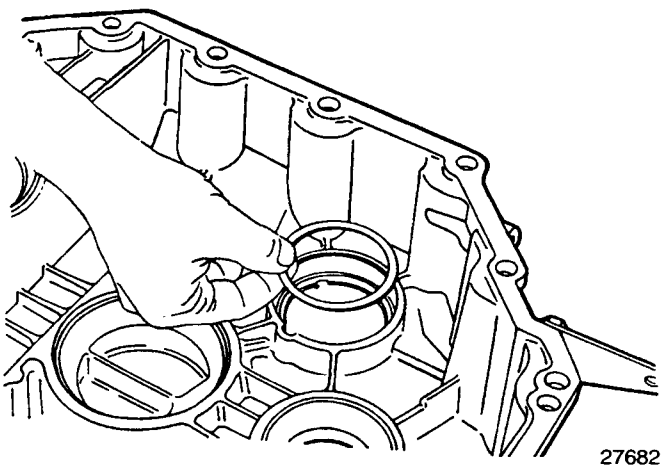
a - Small Diameter Puller Guide

b. Pull bearing cup from housing as shown.



27681

40. Add the necessary amount of shims as determined previously to the appropriate bearing bores.

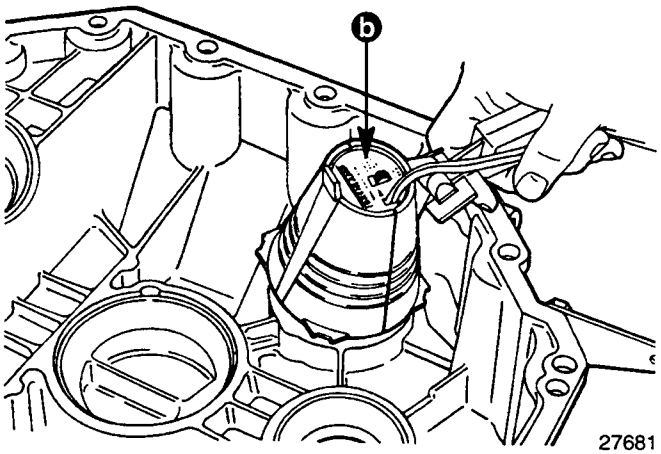


27682

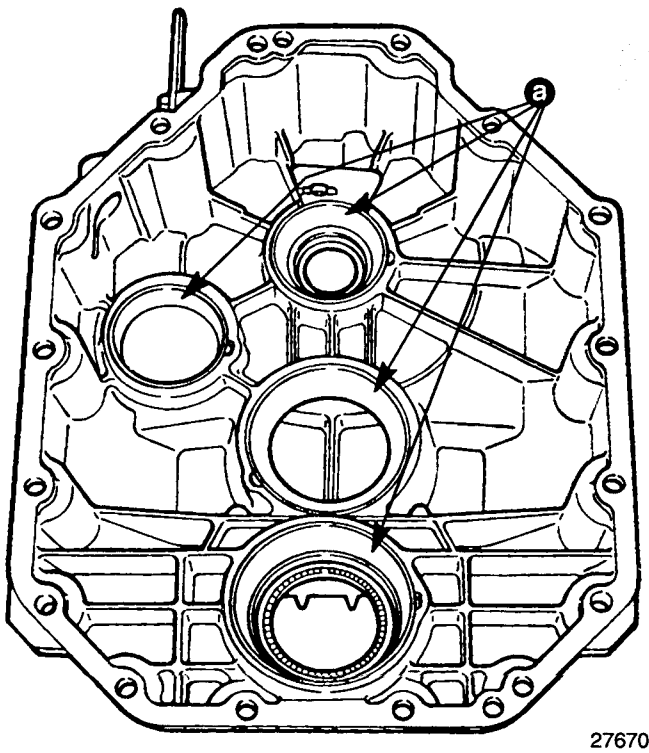
⚠ WARNING

Use care in handling housing once it has been heated with a torch lamp. Severe burns could result. Use special protective gloves when handling housing.

41. Heat each tapered roller bearing cup bore with a torch lamp. Install bearing cups into appropriate bore and tap into place using a suitable mandrel. When housing has cooled (Do Not cool with water), tap bearing cups to ensure they are fully seated.



27681



27670

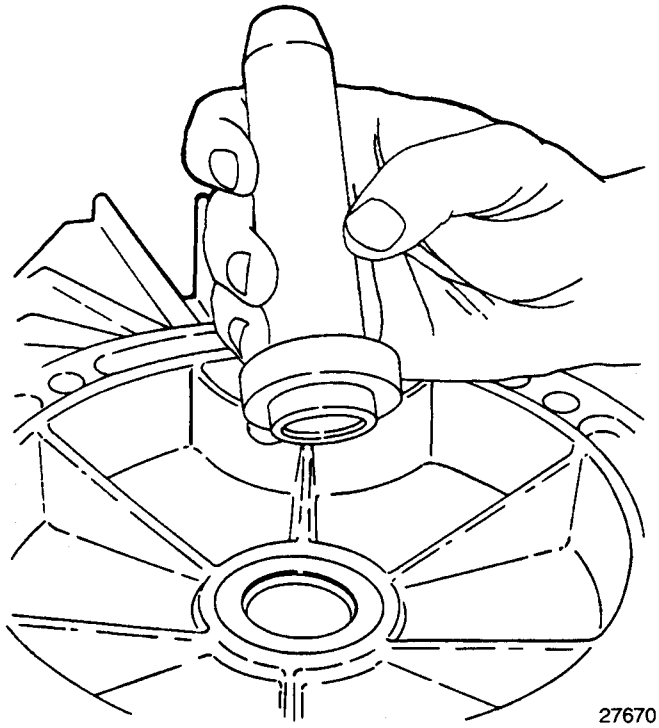
a - Bearing Cups
b - Torch Lamp

Final Assembly

INPUT SHAFT SEAL

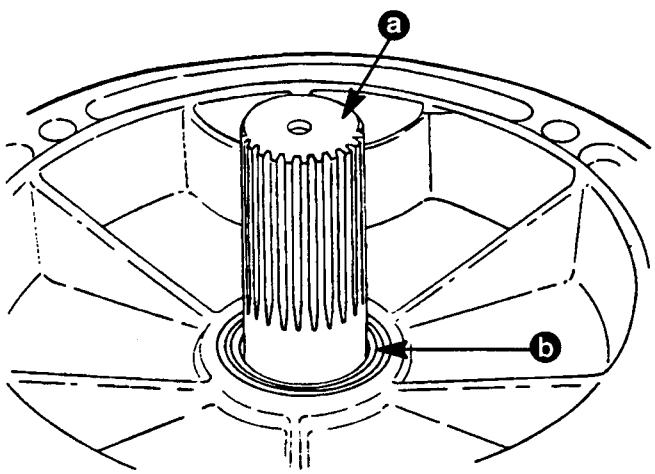
1. Push new seal onto special mandrel. Ensure seal will be positioned with lip of seal facing inward.

   Drive seal uniformly into bore of housing to the point that it is countersunk .040 in. (1mm) with reference to housing surface.



27670

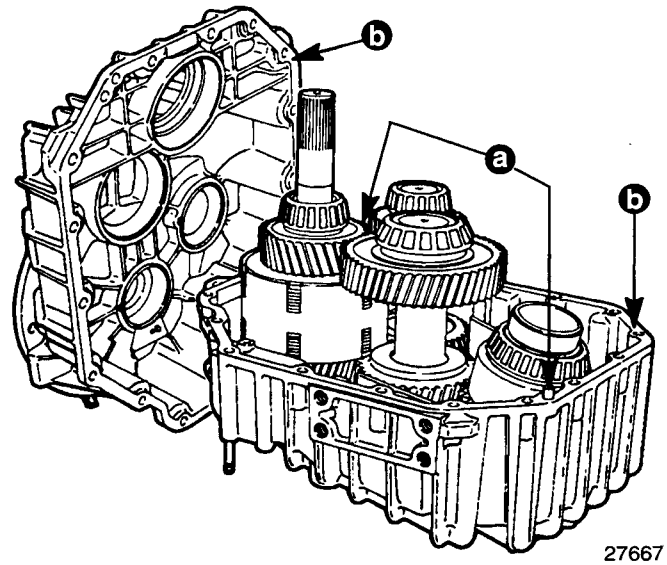
IMPORTANT: Transmissions with 2.0 or 2.5 Gear Ratios - The input shaft seal should not be installed until after the input shaft is installed and housing halves have been joined. (The input shaft must be tilted in order to install the other shafts and this could damage the seal.)



27669

a - Input Shaft
b - Seal

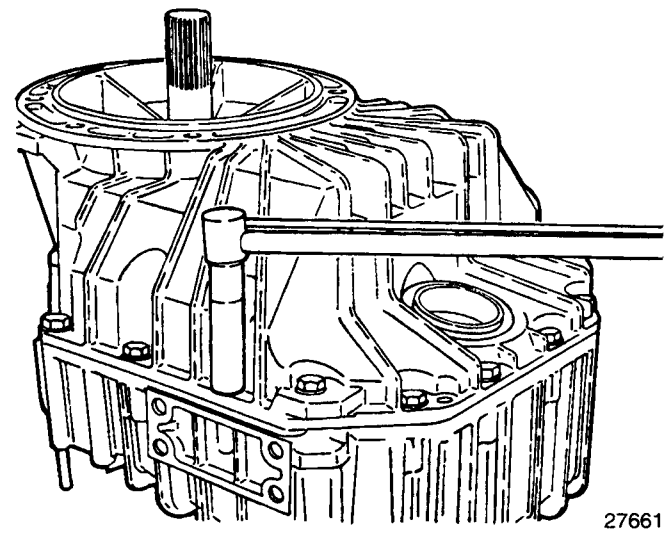
2. Coat lips of seals on input and output shafts with ATF.
3. Apply a thin layer of Loctite 515 Sealer to machined surfaces on housing halves. Reinstall input half of housing. Ensure locator pins are properly positioned.



27667

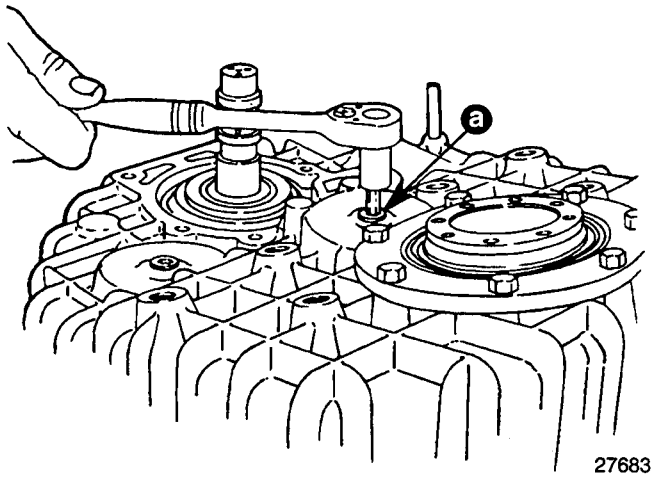
a - Locator Pins
b - Machined Surface

4. Install bolts and lockwashers and torque to 36 lb. ft. (49 N·m).



27661

5. Double check to ensure that there is no shaft clearance on all three shafts. Refer back to previous steps if necessary, and use dial indicator.
6. Remove intermediate shaft hex plugs. Apply a drop of Loctite Type "A" to threads and reinstall in housing. Tighten securely.

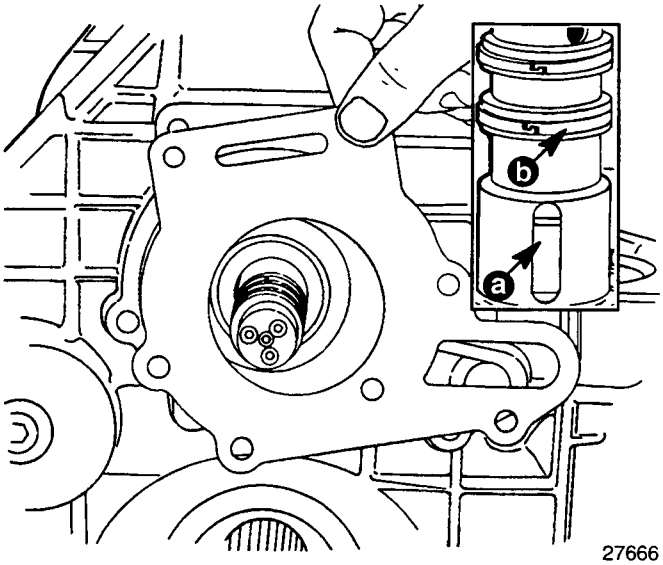


27683

a - Hex Plugs

CONTROL BLOCK

7. Ensure piston rings are in place and the key is in keyway. Align key on shaft with keyway in control block.
8. Install new gasket between control block and housing.

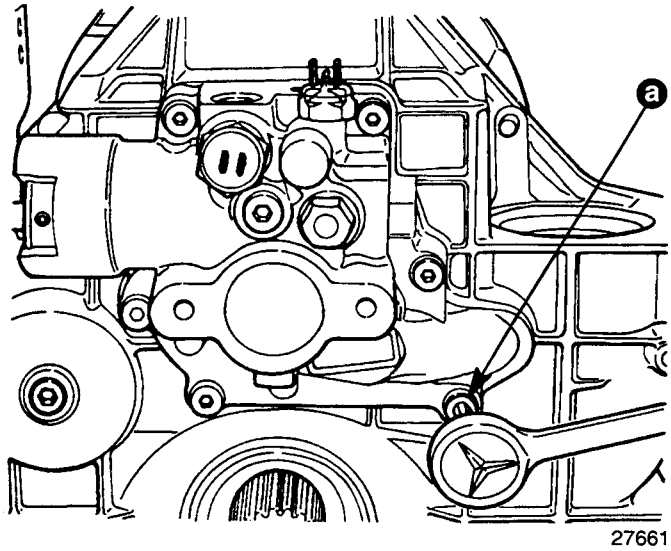


27666

a - Key
b - Piston Rings

Typical Hurth Transmission Shown

9. Carefully push control block onto input shaft.
10. Coat each hex socket head bolt with a drop of Loctite Type "A." Secure control block to housing with bolts and lockwashers. Torque to 18 lb. ft. (25 N·m).



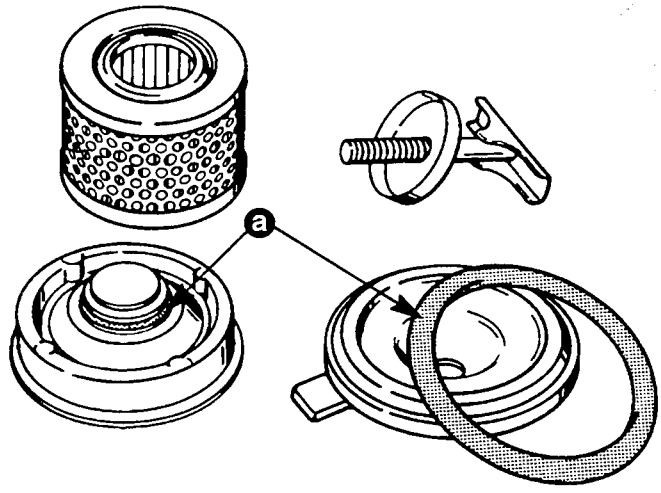
27661

a - Hex Socket Head Bolts (6)

Typical Hurth Transmission Shown

FLUID FILTER

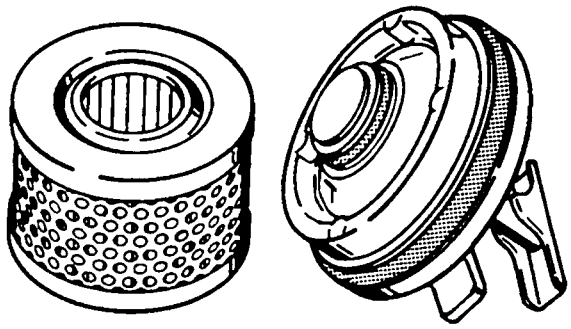
11. Coat new O-rings with ATF.



50975

a - O-rings

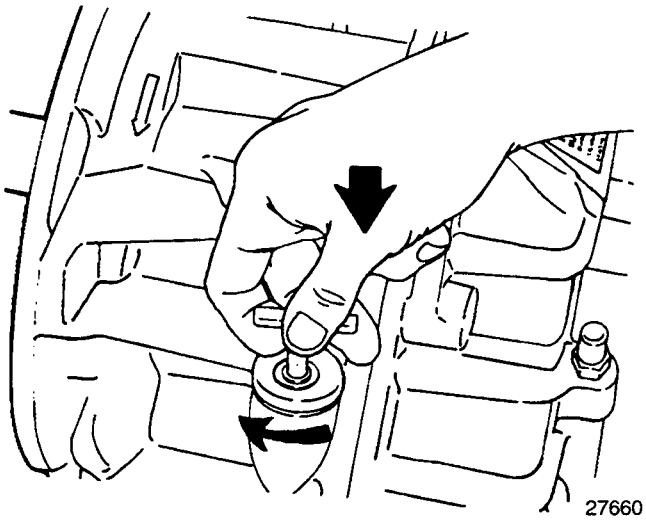
12. Reassemble filter assembly as shown. DO NOT tighten and compress upper O-ring.



50975

DIPSTICK

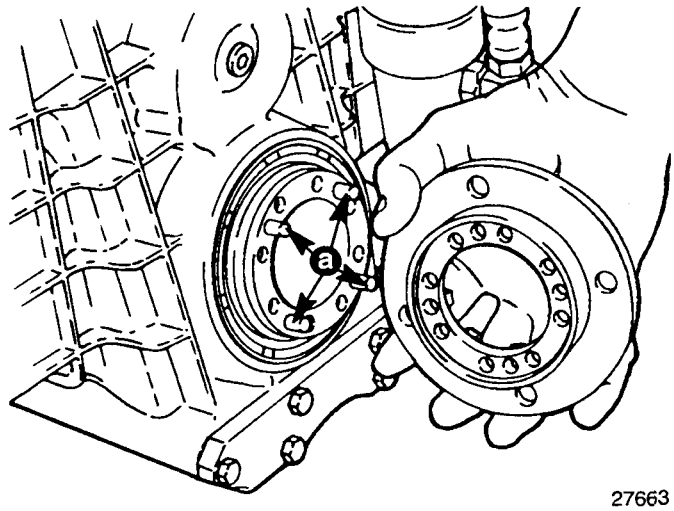
13. Coat sealing ring on dipstick with ATF.
14. Install dipstick into transmission and tighten by pressing down and turning clockwise at the same time.



27660

OUTPUT FLANGE

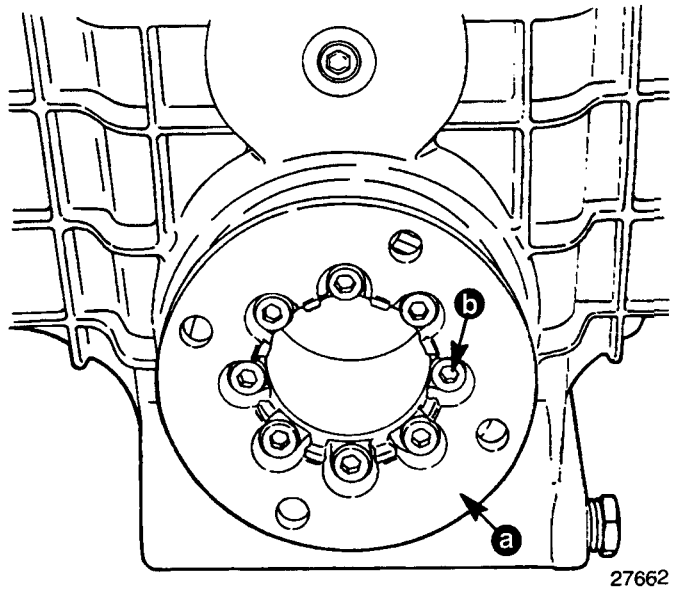
15. Install locator pins (4) into output shaft.



27663

a - Locator Pins

16. Install flange on output shaft. Apply Loctite Type "A" to threads of bolts (8) and torque to 14 lb. ft. (18 N·m).



27662

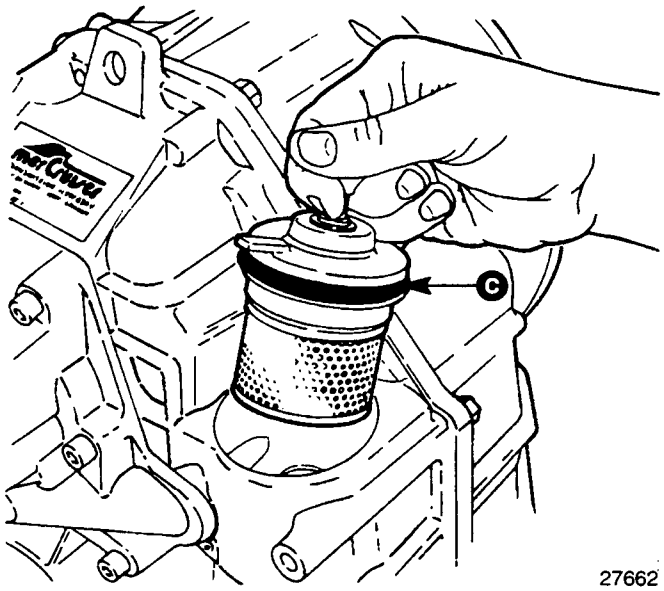
a - Flange
b - Bolts (8)

FILLING WITH TRANSMISSION FLUID

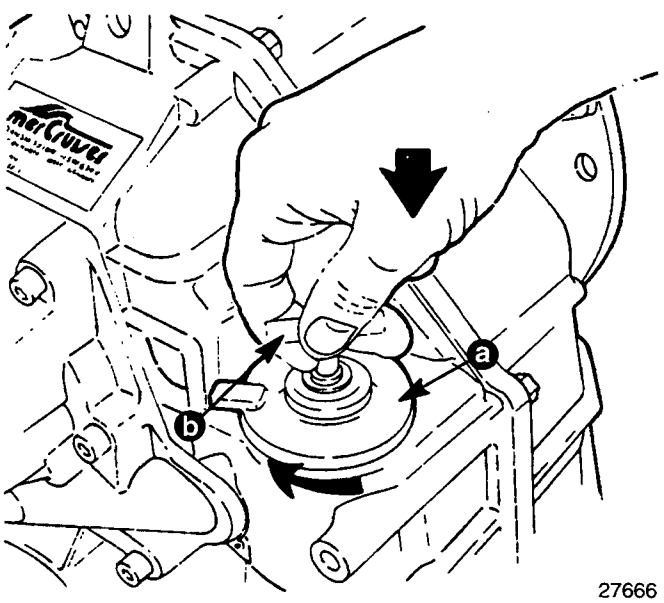
IMPORTANT: Use only ATF (Automatic Transmission Fluid), such as, Dexron II-D.

17. Fill transmission to proper level, thru oil filter cavity. (Refer to specifications for capacity.)

18. Install filter as follows:
    a. Install filter and push down so that cover is flush with housing.
    b. Turn T-handle clockwise until O-ring compresses and cover is snug. Do not overtighten or the O-ring in the cover could be damaged.



27662



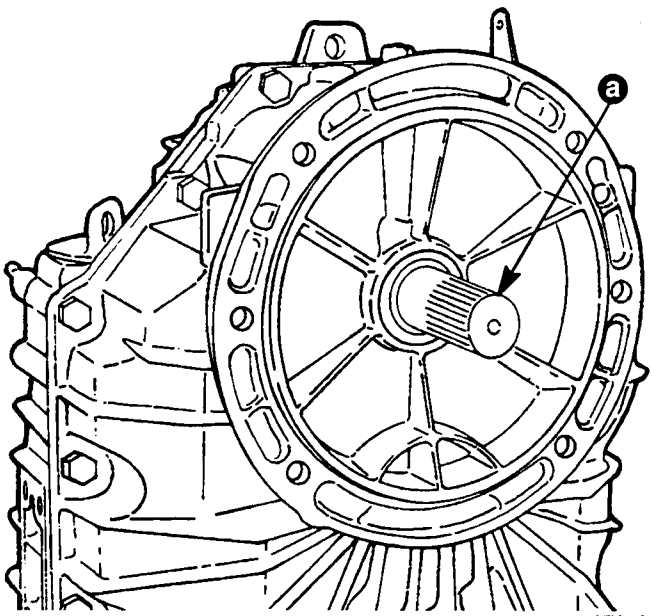
27666

a - Cover
b - T-Handle
c - O-ring

19. Check fluid level. Fluid should be between "MIN" and "MAX" marks on dipstick.

Transmission Installation

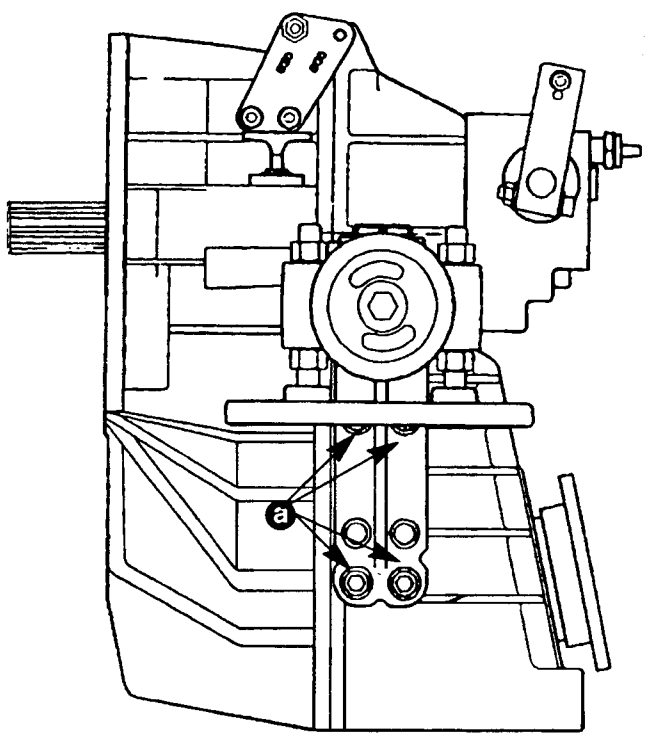
1. Coat splines on input shaft with 2-4-C Marine Lubricant.



27659

a - Input Shaft

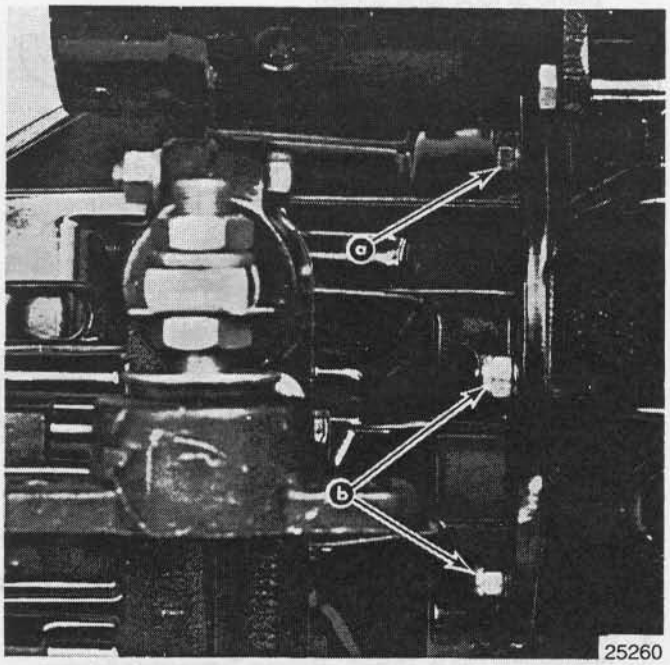
2. Install mounts on transmission housing, having previously inspected for damage and replaced if needed. Torque screws to 50 lb. ft. (68 N·m).



71020

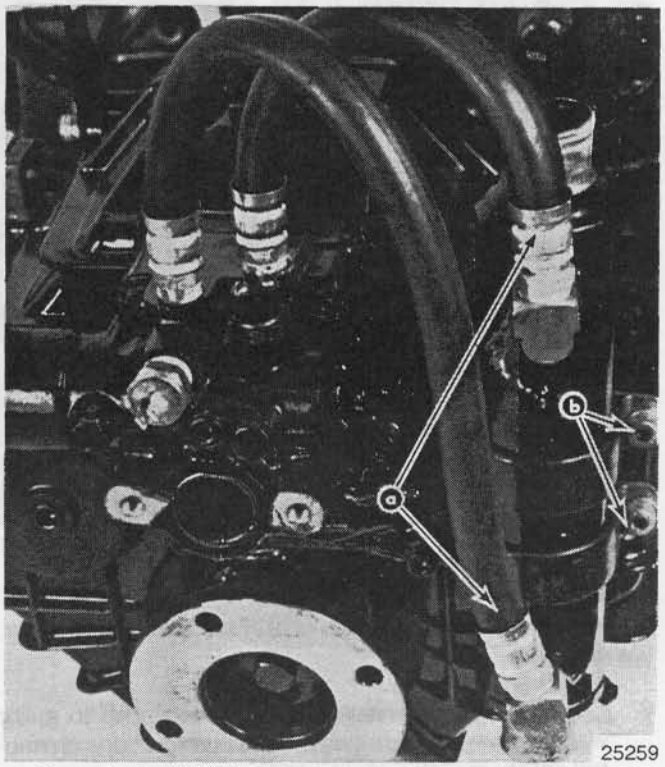
a - Screws [4 Each Side (Upper Two Partially Hidden In This View)]

3. Install transmission on flywheel housing and secure with hardware shown. Torque fasteners to 50 lb. ft. (68 N·m).



a - Bolts [(2) One On Each Side]
b - Locknuts [(4) Two On Each Side]

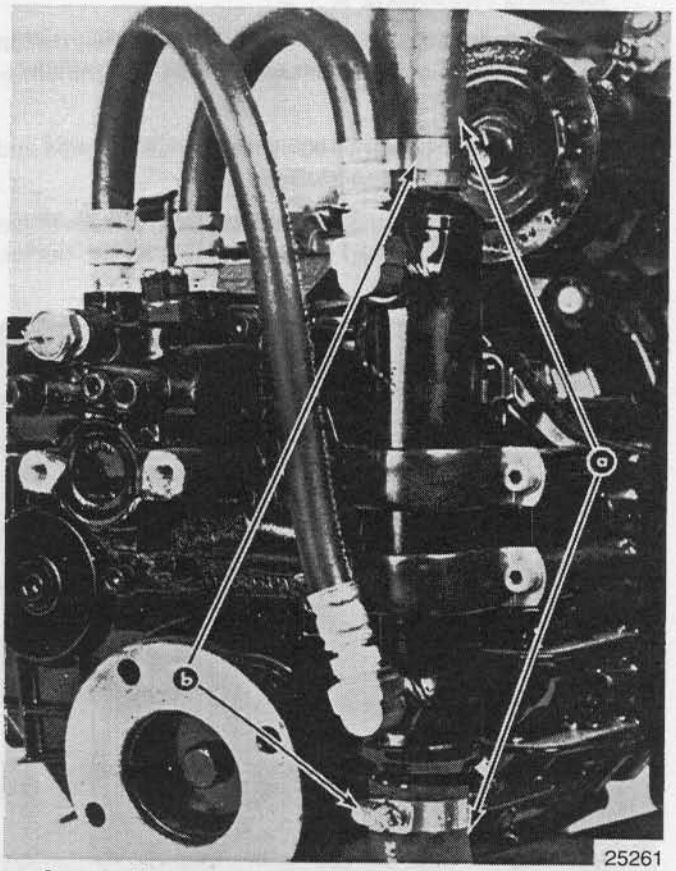
4. Install transmission fluid cooler and hoses as shown following instructions "a" - "c":
   a. Apply a light coat of Loctite Pipe Sealant with teflon to threads of fluid hoses and install on transmission.
   b. Install fluid cooler on transmission with clamps and fasteners. Tighten securely.
   c. Apply a light coat of Loctite Pipe Sealant with teflon to threads of fluid hoses and install on cooler. Tighten securely.



a - Transmission Fluid Hoses
b - Clamps

Typical Hurth Transmission and Fluid Hoses Shown (All Similar)

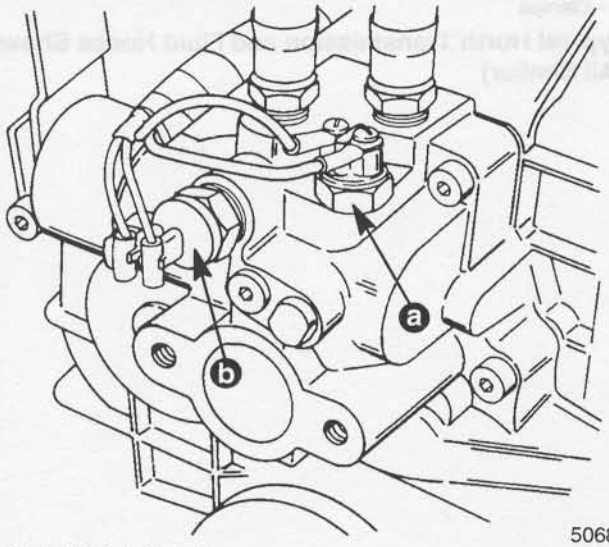
5. Connect seawater hoses to transmission fluid cooler.



a - Seawater Hoses
b - Clamps

Typical Hurth Transmission and Fluid Cooler Shown (All Similar)

6. Connect wires to neutral safety switch and to audio warning temperature switch. Coat connections on neutral safety switch with Liquid Neoprene.

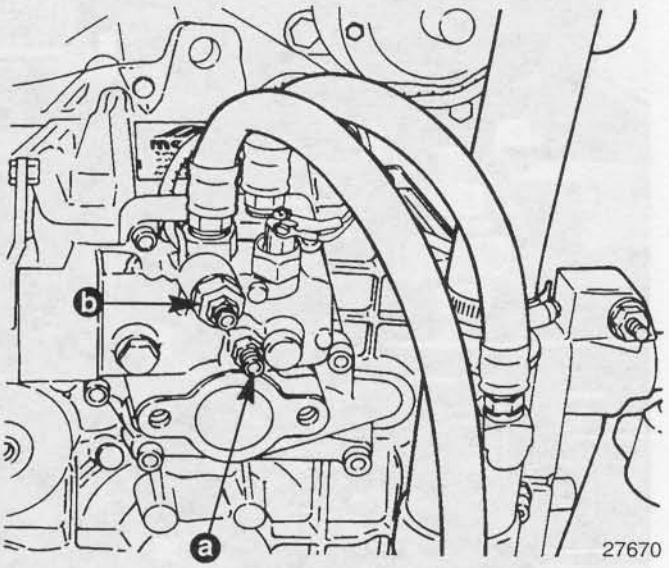


a - Neutral Safety Switch
b - Audio Warning Temperature Switch

7. Refer to Removal and Installation Section 2F - "MIE (Inboard) Models" and install engine and transmission as instructed.

Functional Test

1. Connect a pressure gauge and thermometer to fluid pump at locations shown.



a - Pressure Gauge (M10x1 Thread) - Remove Plug
b - Thermometer (3/8 in. Thread) - Remove Temperature Sender

Typical Hurth Transmission Shown

2. Perform functional tests as shown in chart following. Refer to "Operating Specifications" for correct readings.

Tests to be carried out:

1. Leakages
2. Noise emission
3. Direction of rotation, LH/RH
4. Lube oil temperature
5. Shifting pressure

The function test should be carried out as follows:

Motor speed rpm	Shift lever position	Duration minutes	Tests		
800-1000	neutral	5	1	2	
600-800 (idling speed)	A ↔ B position repeatedly	—	1	2	3
1500-2500	B position	*	1	2	4
600-800 (idling speed)	A ↔ B position repeatedly	—	1	2	3
Idling-max. speed	A position	—	1	2	5**
600-800	from A → B position	—	1	2	
Idling-max. speed	B position	—	1	2	5**

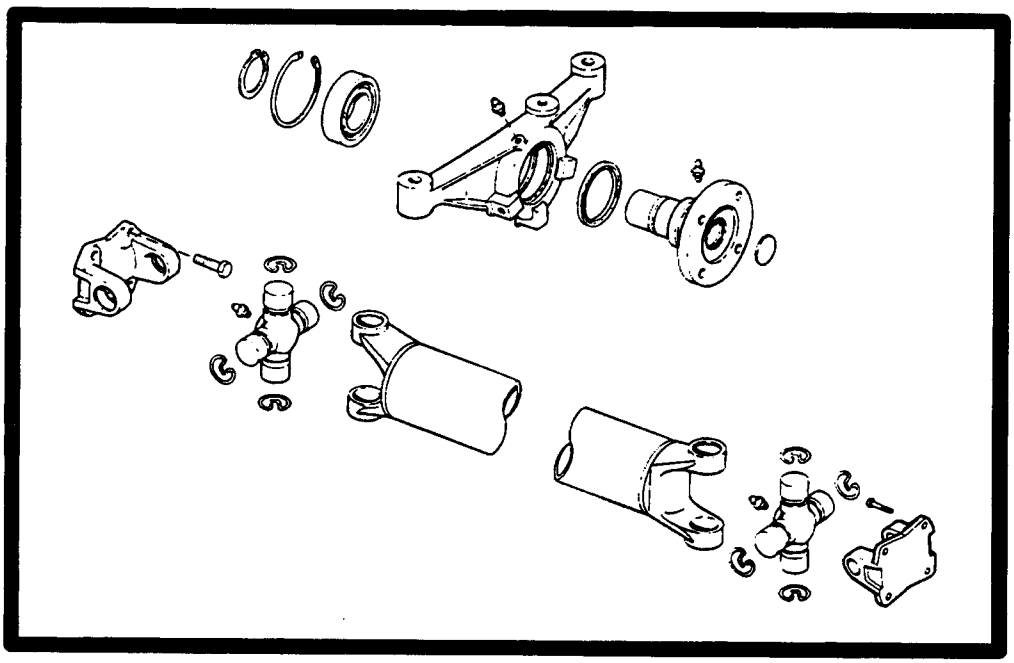
*Until an oil temperature of 75-80° C (167-176° F) has been reached

**at different speeds

DRIVE SYSTEM

8

E



DRIVE SHAFT MODELS/ PROPELLER SHAFT

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Torque Specifications

Fastener Location	Lbs. Ft. (N·m)
Driveshaft to Bearing Support Flange (MCM Models)	50 (68)
Driveshaft to Output Shaft (MCM Models)	50 (68)
Flywheel Housing to Block (MCM Models)	30 (41)
Engine Coupling	35 (48)
Output Shaft Housing to Flywheel Housing (MCM Models)	30 (41)
Propeller Shaft Coupling to Transmission Coupling (MIE Models)	50 (68)

Tools/Lubricants/Sealants

TOOLS/LUBRICANTS/SEALANTS	
91-34569A1	Slide Hammer Puller
92-86154A1	Quicksilver 2-4-C Marine Lubricant
92-32609--1	Quicksilver Loctite A
Loctite 290	Obtain Locally

Flywheel Housing/Output Shaft Housing Repair (MCM 305/350 CID)

NOTICE

The following repair procedure requires removal of the drive shaft. In most cases, because of engine compartment space limitations, the engine also must be removed.

Removal and Installation

1. Remove driveshaft, as outlined following in this SECTION 8E.
2. If engine must be removed, refer to appropriate instructions in SECTION 2.

Disassembly

IMPORTANT: This disassembly procedure, beginning with Step 1, assumes that engine does not require removal from boat. If, however, engine removal is required, refer to "SECTION 2" for removal and installation instructions. With engine removed from boat, proceed with disassembly, beginning with Step 3.

1. Support rear of engine with overhead hoist or wooden blocks under the rear of the engine.
2. Remove stringer bolts (rear engine mounts).
3. Remove output shaft housing attaching screws; then, remove housing.
4. Remove snap ring; then, pull output shaft out of housing.
5. Remove snap ring from housing.
6. Using Slide Hammer Puller, remove bearing from housing.
7. Remove flywheel cover.
8. Remove flywheel housing.
9. Remove engine coupling.
10. Clean and inspect all parts. Replace any damaged parts.

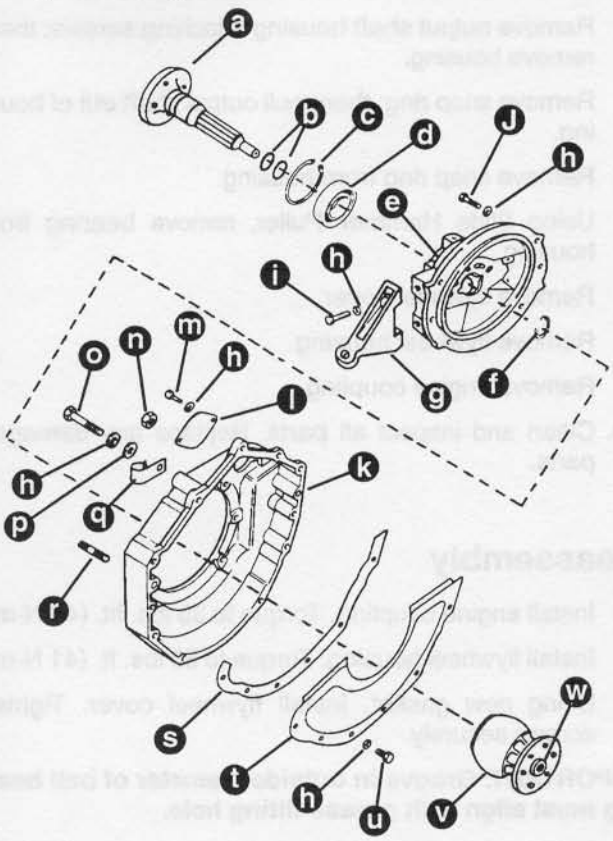
Reassembly

1. Install engine coupling. Torque to 35 lbs. fit. (48 N·m).
2. Install flywheel housing. Torque to 30 lbs. ft. (41 N·m).
3. Using new gasket, install flywheel cover. Tighten screws securely.

IMPORTANT: Groove in outside diameter of ball bearing must align with grease fitting hole.

4. Install ball bearing into output shaft housing; then, install snap ring.
5. Apply 2-4-C Marine Lubricant to O-rings (on output shaft), then slide shaft thru bearing. Secure shaft with snap ring.
6. Apply 2-4-C Marine Lubricant to splines on output shaft.

7. Install output shaft housing to flywheel housing. Torque screws to 30 lbs. ft. (48 N·m).
8. Secure rear engine mounts to stringer with bolts. Tighten securely.
9. Remove hoist (or wooden blocks).
10. Install drive shaft and check alignment. (Refer to SECTION 2 for engine and driveshaft alignment if engine was removed.)
11. Using 2-4-C Marine Lubricant, grease ball bearing thru grease fitting.



a - Output Shaft
b - O-rings
c - Snap Ring - Ball Bearing
d - Ball Bearing
e - Shaft Housing
f - Snap Ring - Output Shaft
g - Rear Engine Mount (2)
h - Lockwasher
i - Screw (4)
j - Screw (6)
k - Flywheel Housing
l - Plate
m - Screw (2)
n - Nut (1)
o - Screw (4)
p - Washer (1)
q - Clamp (1)
r - Stud (1)
s - Gasket
t - Cover - Flywheel
u - Screw (7)
v - Coupling - Engine
w - Bushing

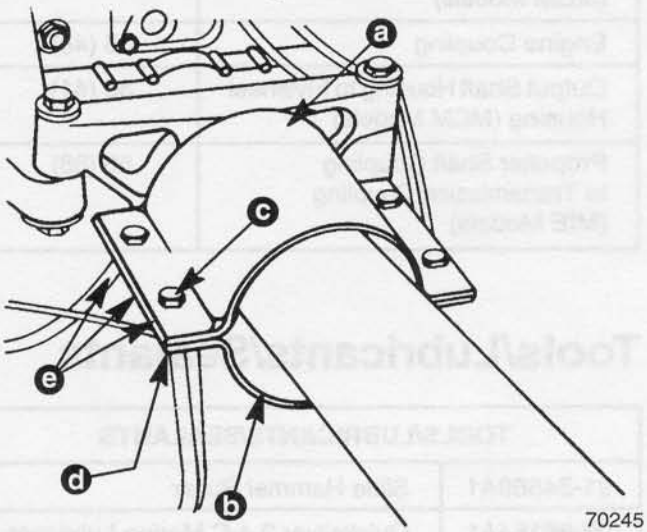
Flywheel Housing/Output Shaft Housing

Drive Shaft Repair (MCM 305/350 CID)

Removal

IMPORTANT: It is not necessary to remove the engine to service the drive shaft.

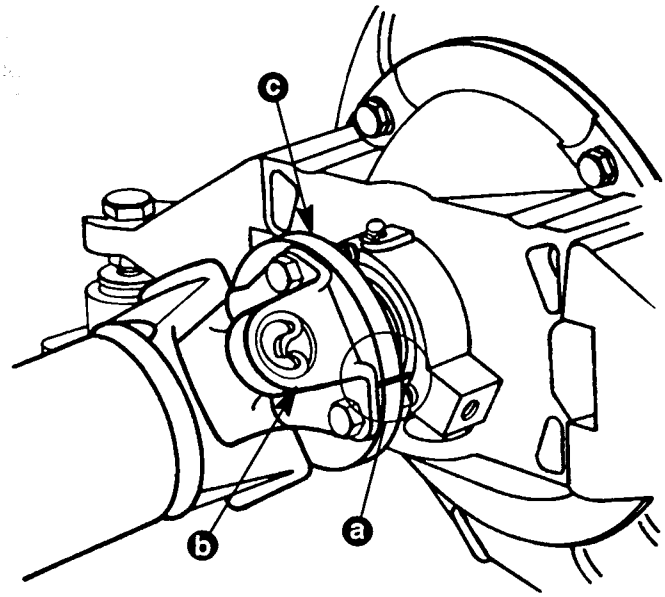
1. Remove top and bottom drive shaft shields around transom end and engine end of drive shaft.



a - Top Shield
b - Bottom Shield
c - Bolt [3/8 in.-16 x 7/8 in. (22.2 mm); 4 Used]
d - Nut (3/8 in.-16; 4 Used)
e - Screws (3 Used - Hidden In This View)

Top Shield and Bottom Shield at Transom End (Engine End Similar)

2. Suitably mark drive shaft U-joint yokes/flange connections (engine output and drive unit input) to assist in exact same positioning during assembly at engine and transom end.

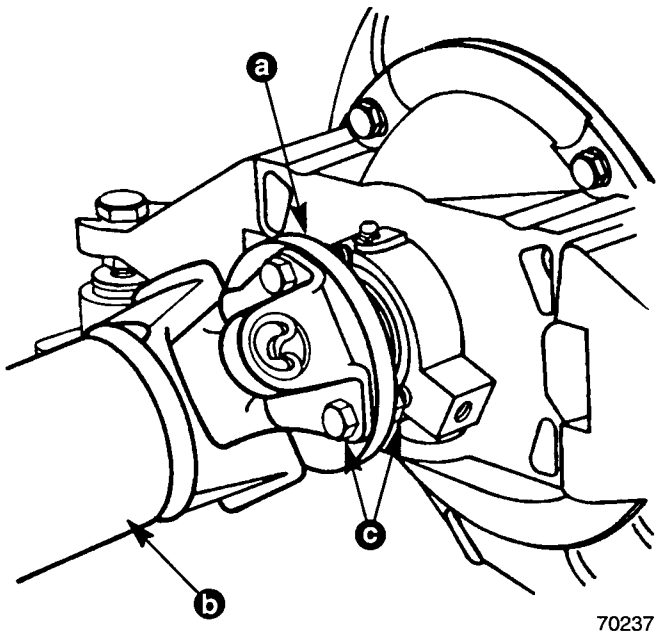


70237

a - Suitable Mark On Flange and Drive Shaft Connection
b - Extension Drive Shaft U-Joint Yoke
c - Flange

Engine End Shown (Transom End Similar)

3. Remove drive shaft fasteners and driveshaft.



70237

a - Output Shaft Flange
b - Drive Shaft
c - Screw with Nut (4 Total)

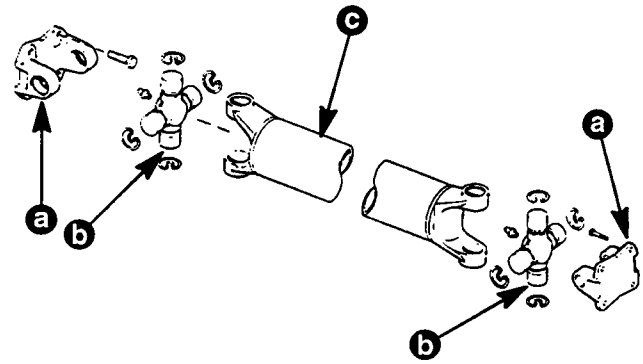
Engine End Shown (Transom End Similar)

Repair

⚠ CAUTION

Be sure U-joint locking rings are seated properly after replacing U-joints.

1. Replace U-joints, if required.
2. Replace flange, if required.

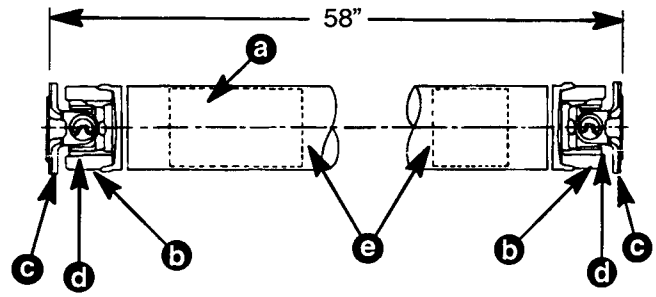


a - Flange
b - U-Joint
c - Drive Shaft

Drive Shaft

Replacement Drive Shafts

Currently, MerCruiser is furnishing a standard 58 in. (147.3 cm) long drive shaft with all Extension Shaft Models. Some boat manufacturers modify the drive shafts to a shorter length. Because of this, use the following procedure to obtain replacement drive shafts.



a - Tube
b - Yoke - Tube
c - Flange
d - Universal Joint
e - Sound Deadener (Cardboard Tube)

Extension Drive Shaft

58 In. (147.3 cm) Long (Standard Length) Drive Shaft:

The complete drive shaft can be ordered from Mercury Marine.

Drive Shafts Modified to Shorter Lengths:

The complete modified (shortened) drive shaft has to be ordered from the boat manufacturer that installed the MerCruiser Power Package.

IMPORTANT: Dana Corporation - Spicer Regional Drive Shaft Centers will not shorten replacement drive shafts for dealers or consumers.

If a boat manufacturer is currently having Extension Drive Shafts modified, they must be modified by one of Dana Corporation - Spicer Regional Drive Shaft Centers to maintain Mercury Marine warranty. The modified drive shaft must meet the following specifications.

- **U-joints aligned radially within 0° (± 1/2°).**
- **U-joints greased after welding with Quicksilver 2-4-C Marine Lubricant.**
- **Assembly balanced with within 1.5 oz. in. to 4500 RPM.**
- **Tube to have .005 in. (.127 mm) - .010 in. (.254 mm) interference fit with tube yoke.**
- **Tube must be straight and round within .015 in. (.381 mm).**

Installation

IMPORTANT: The following instructions are to be used if ONLY the drive shaft was removed for service. Refer to appropriate sections for installation of other components which require special alignment.

1. Grease both drive shaft universal joints with 2-4-C Marine Lubricant.

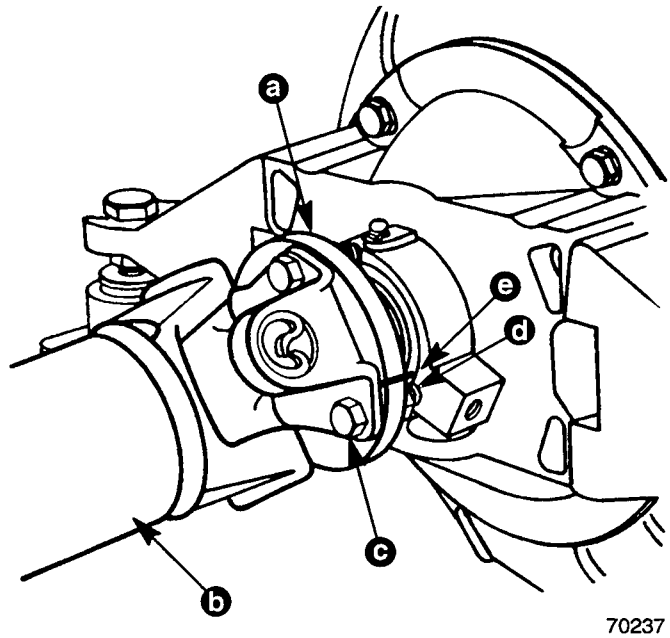
⚠ CAUTION

When attaching shaft in next step, BE SURE that the pilot on drive shaft flanges are engaged in input shaft and output shaft flanges. Flanges MUST BE flush to each other prior to tightening screws or screws may come loose during operation.

⚠ CAUTION

Failure to properly align shaft flanges with matching marks made on disassembly may cause improperly aligned drive unit and extension drive shaft U-joint centerlines resulting in a severe vibration problem.

2. As shown, attach drive shaft output flange and input shaft flange exactly as marked upon disassembly. Torque fasteners to 50 lb. ft. (68 N·m).

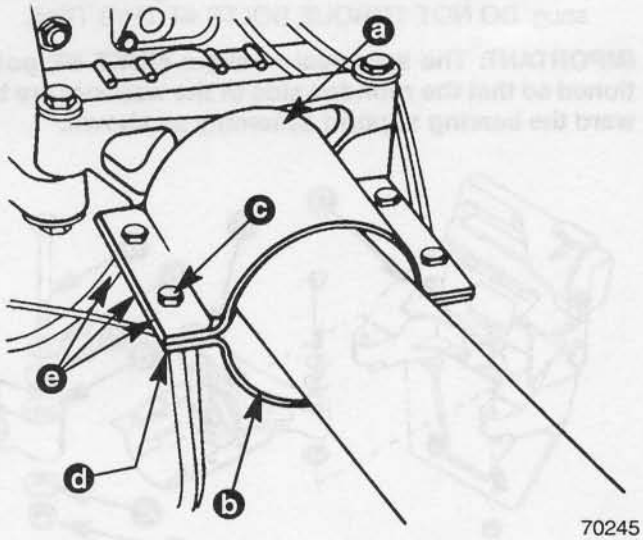


70237

a - Output Shaft Flange
b - Drive Shaft
c - Screw 7/16 in. - 20 x 1-1/2 in. (38 mm) Long (4 Used) [Torque to 50 lb. ft. (68 N·m)]
d - Nut 7/16 in. - 20 (4 Used)
e - Suitable Matching Marks Made Upon Disassembly - Aligned

Engine End Shown (Transom End Similar)

3. Apply Loctite 271 to threads of bottom drive shaft shield retaining screws and install bottom shields on engine and transom end. Then install both top shields as shown. Torque all fasteners to 30 lb. ft. (41 N·m).



70245

a - Top Shield
b - Bottom Shield
c - Bolt [3/8 in. - 16 x 7/8 in. (22.2 mm); 4 Used]
d - Nut (3/8 in. - 16; 4 Used)
e - Screws [3 Used - Hidden In This View (Use Loctite 271)]

Top Shield and Bottom Shield at Transom End (Engine End Similar)

Bearing Support Repair (MCM 305/350 CID)

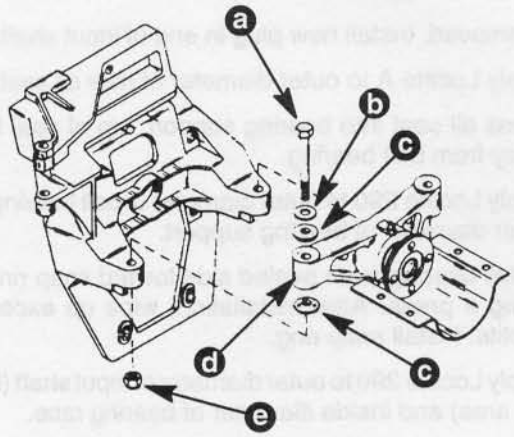
Removal

IMPORTANT: It is not necessary to remove the engine to service the drive shaft and/or bearing support.

⚠CAUTION

It IS necessary to remove the stern drive unit (to properly align drive unit U-joint centerline with extension drive shaft U-joint centerlines) if bearing support is removed, or a severe vibration problem will occur.

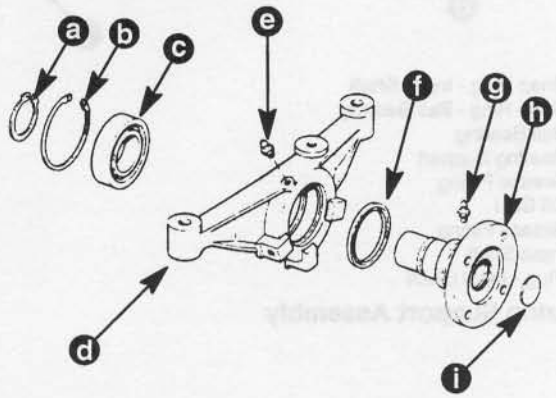
1. Remove drive shaft as previously outlined.
2. Remove stern drive unit (refer to appropriate "Stern Drive Service Manual").
3. Remove bearing support and retain hardware.



a - Bolt, Bearing Support (2)
b - Flat Washer (2)
c - Spherical Washer (4) (Install with Rounded Side Toward Bearing Support)
d - Bearing Support (Tailstock)
e - Nut (2)

Disassembly

1. Remove snap ring; then, remove input shaft.
2. Remove larger snap ring.
3. Using Slide Hammer Puller, remove ball bearing.
4. Remove oil seal.
5. If required, remove plug from end of input shaft.
6. Clean and inspect all parts.
7. Replace any damaged parts.



a - Snap Ring - Input Shaft
b - Snap Ring - Ball Bearing
c - Ball Bearing
d - Bearing Support
e - Grease Fitting
f - Oil Seal
g - Grease Fitting
h - Input Shaft
i - Plug - Input Shaft

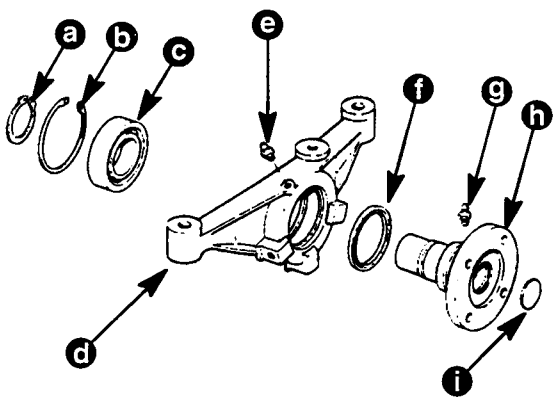
Bearing Support Assembly

Reassembly

1. If removed, install new plug in end of input shaft.
2. Apply Loctite A to outer diameter of new oil seal.
3. Press oil seal into bearing support. Lip of seal faces away from ball bearing.
4. Apply Loctite 290 to outer diameter of ball bearing and inner diameter of bearing support.
5. Install bearing (with sealed side toward snap ring) by using a press. After installation, wipe up excessive Loctite. Install snap ring.
6. Apply Loctite 290 to outer diameter of input shaft (bearing area) and inside diameter of bearing race.
7. Install input shaft; then, install snap ring. Wipe up excessive Loctite.

IMPORTANT: Do not let Loctite get into ball bearing.

8. Fill bearing area with 2-4-C Marine Lubricant thru grease fitting.
9. Apply 2-4-C Marine Lubricant to splines of input shaft before installing drive unit.



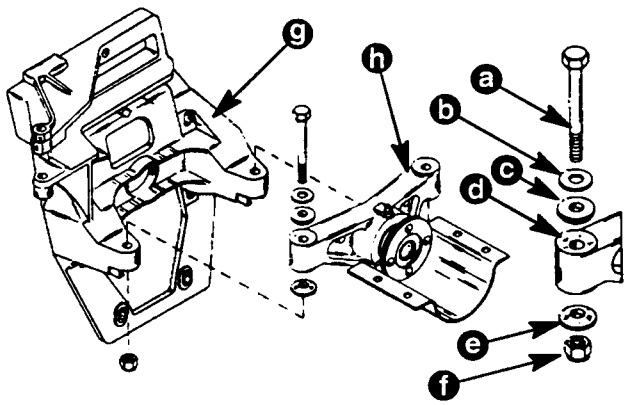
a - Snap Ring - Input Shaft
b - Snap Ring - Ball Bearing
c - Ball Bearing
d - Bearing Support
e - Grease Fitting
f - Oil Seal
g - Grease Fitting
h - Input Shaft
i - Plug - Input Shaft

Bearing Support Assembly

Installation

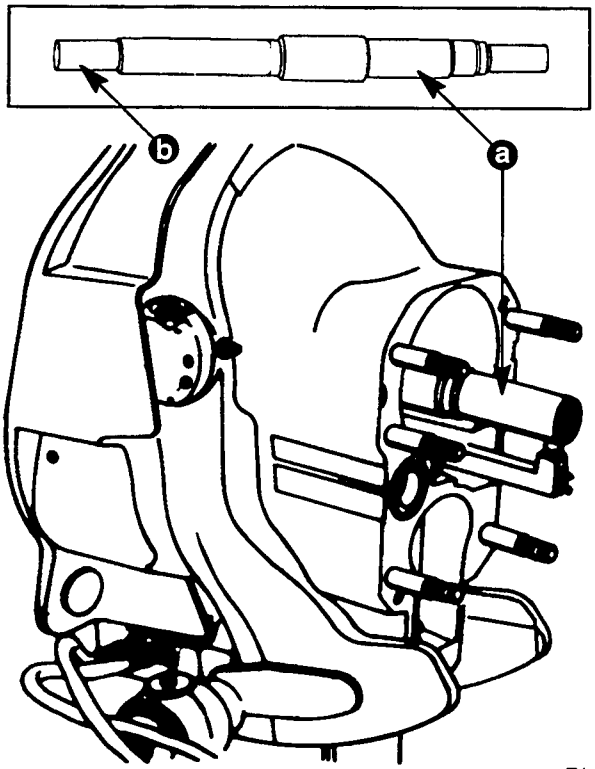
1. Install bearing support assembly (tailstock) on transom plate using hardware as shown. Tighten bolts until snug. DO NOT TORQUE BOLTS AT THIS TIME.

IMPORTANT: The spherical washers MUST BE positioned so that the rounded side of the washers are toward the bearing support assembly as shown.



a - Bolts 1/2 in. - 20 x 4 in. (102 mm) Long
b - Steel Washer (Flat)
c - Spherical Washer (Rounded on One Side)
d - Bearing Support
e - Spherical Washer (Rounded on One Side)
f - Nut 1/2 in. - 20
g - Transom Plate
h - Bearing Support (Tailstock)

2. Insert solid end of Alignment Tool 91-57797A3 through bearing in gimbal housing and into input shaft splines of bearing support.



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a - Alignment Tool (Use only Quicksilver Alignment Tool 91-57797A3)
b - Insert This End of Alignment Tool Through Gimbal Housing Assembly

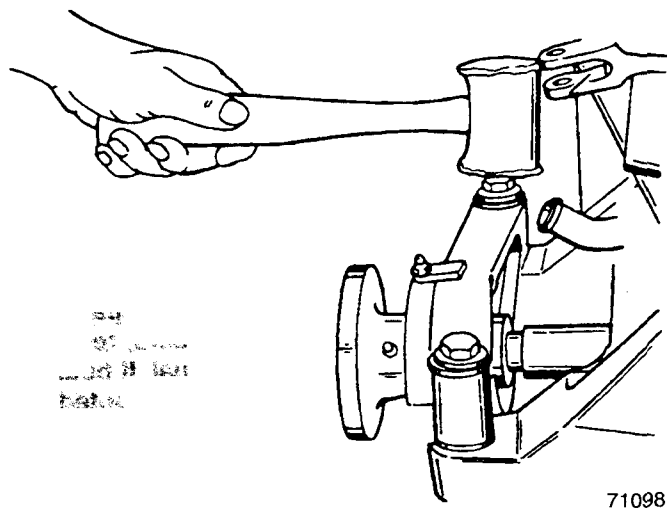
Typical Stern Drive Unit Shown

3. DO NOT remove Alignment Tool from gimbal housing.

⚠ CAUTION

Both attaching bolts MUST BE struck firmly in the following step to properly seat spherical washers. If procedure is not followed, difficulty in the installation of the stern drive may be experienced and subsequent damage to input bearing may result.

4. Strike the head of BOTH bearing support attaching bolts firmly with a hammer.



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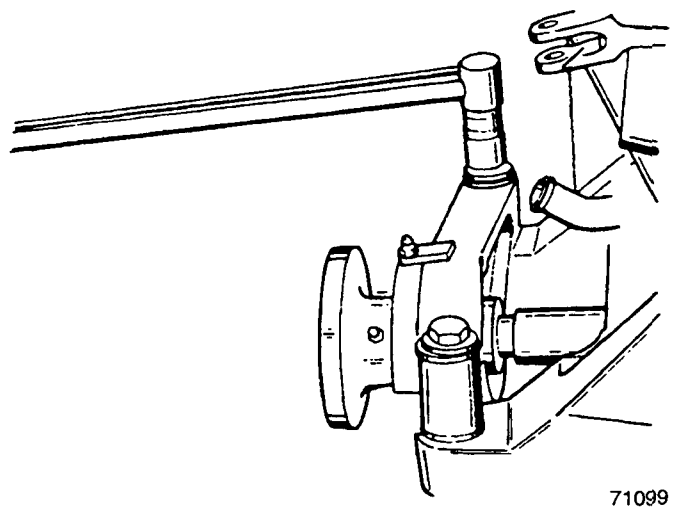
5. Torque bolts to 35-54 lb. ft. (47-54 N·m) as shown.



71099

6. Refer to appropriate "Stern Drive Service Manual" and install drive unit.
7. Refer to appropriate SECTION 2 - REMOVAL AND INSTALLATION - Engine Installation/Alignment, if engine was removed.

Propeller Shaft (MIE Inboard Models)

NOTICE

The following information can be used as a guide for determining vibration problems on boats powered by inboard engines (MIE Models). For installation, alignment and repairs to shafts, struts, shaft logs and rudders, refer to boat manufacturer's service manual. If boat is equipped with V-Drive, or a remote mounted V-Drive, refer to V-Drive "SECTION 8D" or boat manufacturer's service manuals for all servicing and troubleshooting. For MIE engine installation and alignment, refer to "SECTION 2, Part F".

Checks Made While Boat is in Water

1. Disconnect propeller shaft coupling from transmission coupling.
2. Check fit of coupling to propeller shaft.

Straight Bore Type:

a. Loosen set screws.

b. Try to move coupling by hand. The bore of the coupling should be a semi press fit to shaft.

c. Check shaft for wear. If worn, replacement fo shaft may be necessary.

d. If shaft is not worn, try another coupling.

Tapered Bore Type:

a. Check nut on shaft for tightness.

b. If nut was loose, remove coupling and check for damage to taper on shaft or in coupling.

c. Replace worn parts.

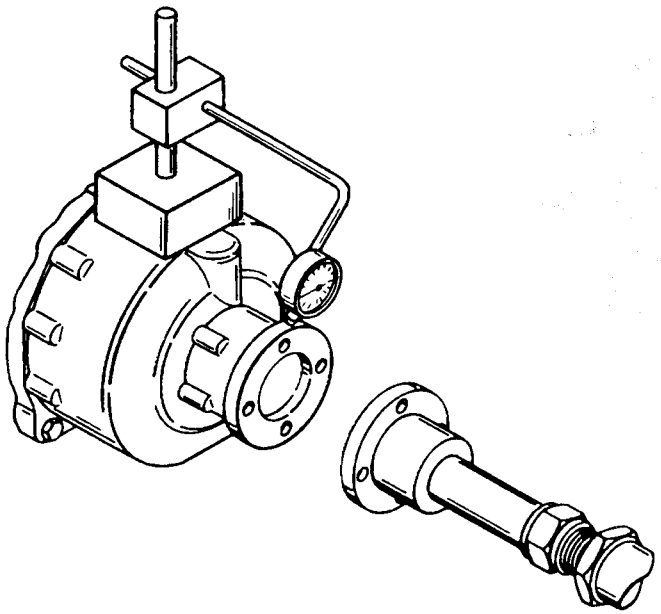
d. Always make sure key is not sticking out of coupling.

e. Install coupling on shaft without the key.

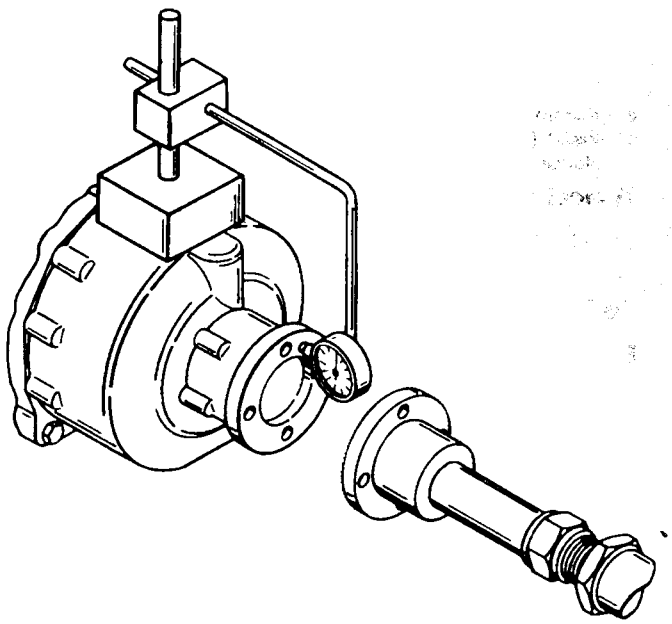
f. Mark the shaft (behind the coupling); then, remove the coupling.

g. Now install the key and coupling. Make sure coupling still lines up with the mark. This ensures that key is not oversize and holding the tapers apart.

3. Check output coupling flange of transmission.



Checking Coupling Outside Diameter - Rotate 1 Complete Turn



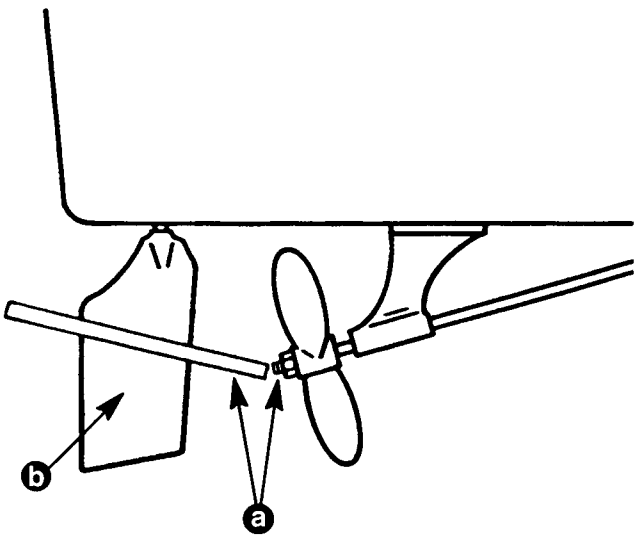
Checking Coupling Face - Rotate 1 Complete Turn

4. If there is movement in step 3, replace output coupling.
5. Replace damaged parts and realign engine as outlined.
6. Torque propeller shaft coupling and transmission coupling (output flange) to 50 lb. ft. (68 N·m). Tighten set screws securely, if so equipped. Safety wire set screws, if so equipped.

Checks Made with Boat Out of Water and Shaft Installed

Possible causes for vibration may be propeller shaft, propeller to shaft fit or propeller. All three can be checked by using the rudder, a strong metal straight edge and a "C" clamp.

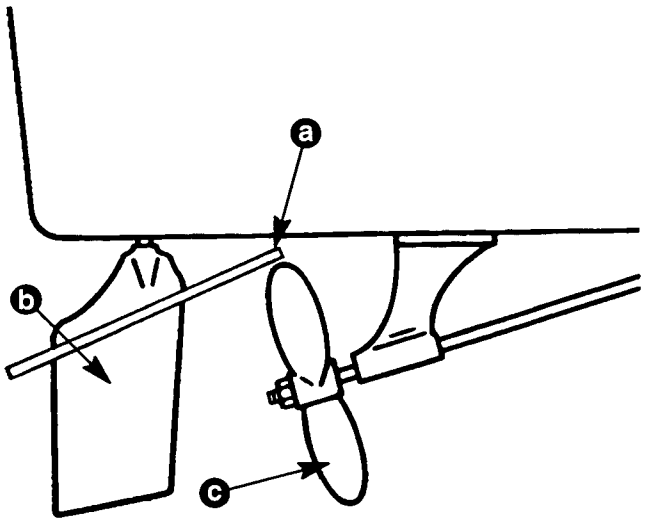
1. Check installation of propeller to shaft.
   a. Remove propeller.
   b. Check for chipped or cracked keyway in propeller on shaft without key.
   c. Install propeller on shaft without key.
   d. Mark the shaft (behind the propeller); then, remove propeller.
   e. Install the key and propeller. Make sure propeller still lines up with mark. This ensures that key is not oversize and holding the tapers apart. Retighten propeller nut.
   f. Be sure key is not sticking out of propeller.
2. Check for propeller shaft being bent behind the strut.



a - Metal Straight Edge (Held to Rudder with "C" Clamp) - Position Corner of Straight Edge at Center of Shaft. Rotate Shaft 1 Complete Turn. If Shaft "Wobbles", Replace Shaft.
b - Rudder

Checking for Bent Shaft

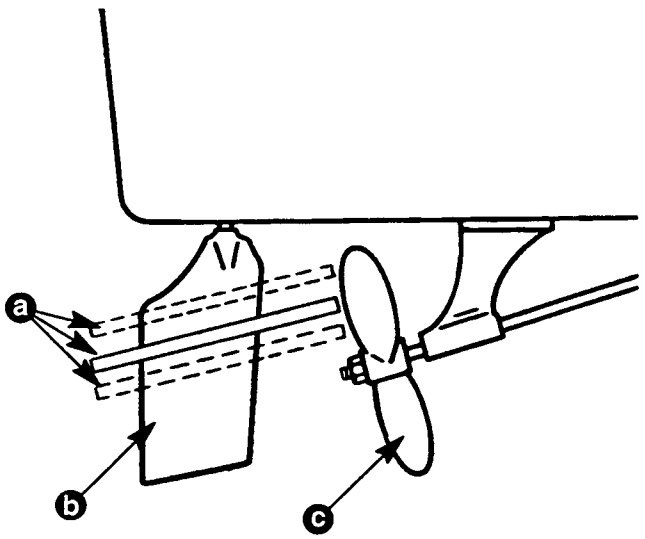
3. Check the diameter of all propeller blades. If not the same, repair propeller.



a - Metal Straight Edge (Held to Rudder with "C" Clamp)
b - Rudder
c - Rotate Propeller 1 Complete Turn

Checking Propeller Diameter

4. Check that all propeller blades are the same pitch and that it is properly seated on shaft. Repair or replace if necessary.

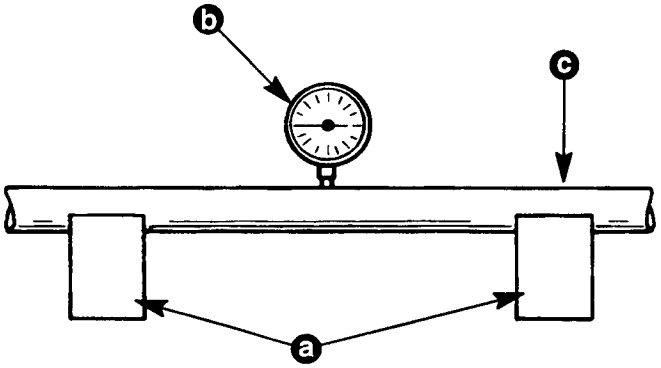


a - Metal Straight Edge (Held to Rudder with "C" Clamp)
b - Rudder
c - Rotate Propeller 1 Complete Turn. Check at 3 Different Points on Blades

Checking Propeller Pitch and for Proper Seating

Checks Made with Propeller Shaft Removed form Boat

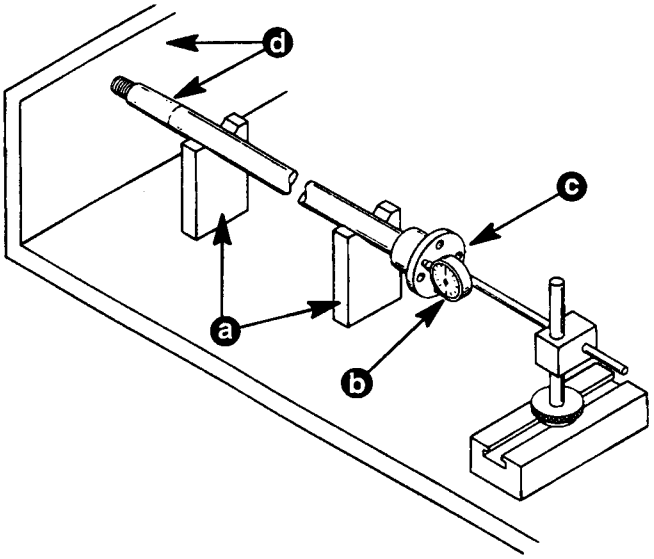
1. Check propeller shaft for straightness. Check at 3 or 4 places. Any bend over .004 in. (.1016 mm), replace shaft.



a - Vee Blocks
b - Dial Indicator
c - Shaft - Rotate 1 Complete Turn

Checking for Bent Shaft

2. Check that bore of coupling is 90 degrees from coupling flange. Replace coupling if needle moves.

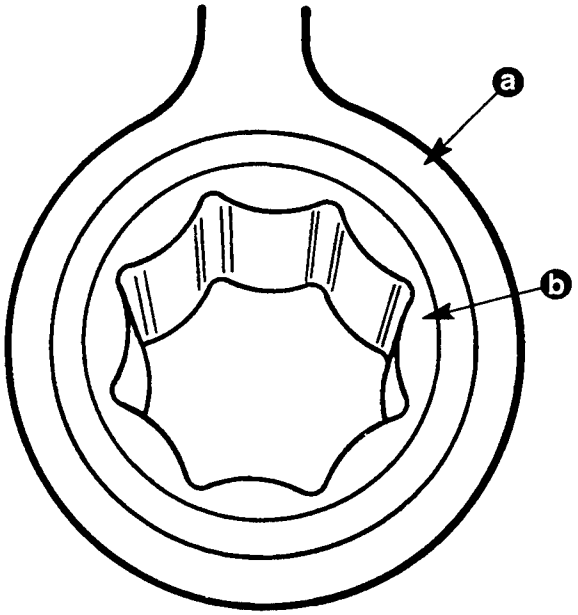


a - Vee Blocks
b - Dial Indicator
c - Coupling Flange - Rotate 1 Complete Turn
d - Shaft Against Block to Prevent Fore and Aft Movement

Checking Coupling Bore

Strut

Refer to boat manufacturer's service manual for alignment and replacement. Normally, the shaft should be centered in the cutlass bearing. Shims (placed between the strut and hull) are used to align the strut to the shaft.



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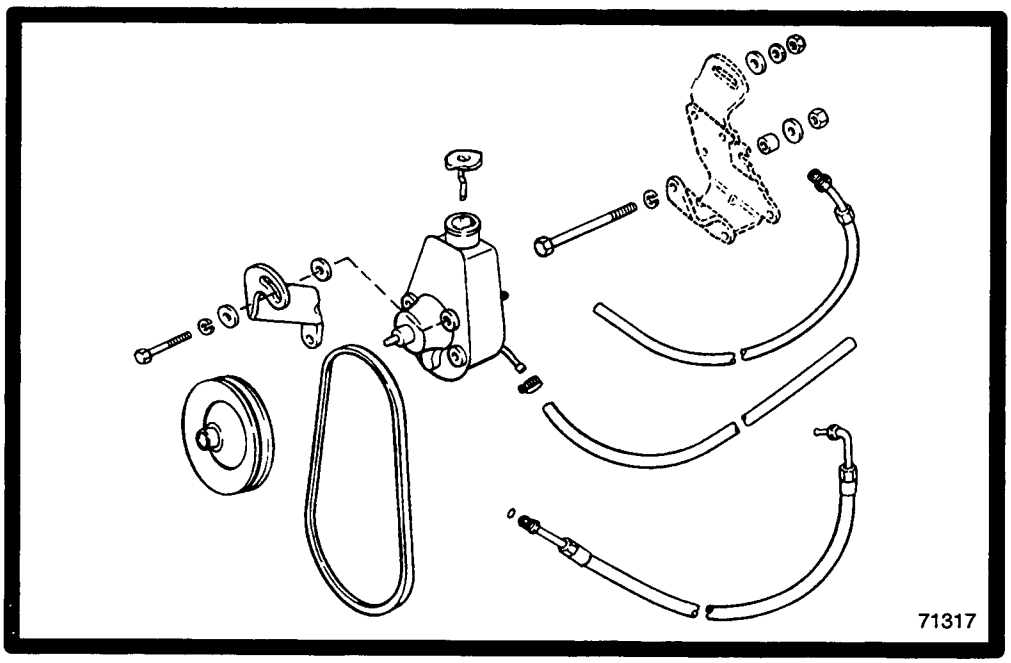
a - Strut
b - Cutlass Bearing

Strut

POWER STEERING

9

A



POWER STEERING SYSTEM

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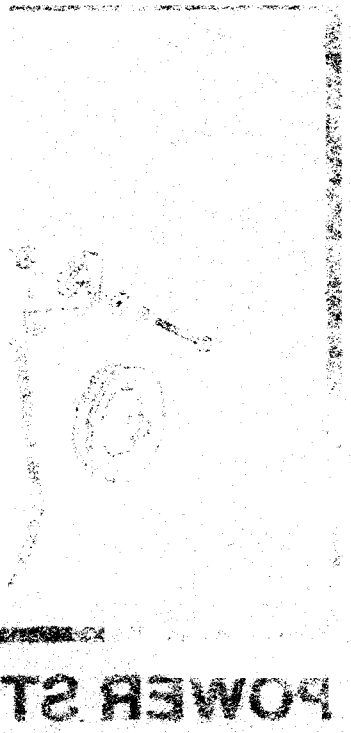


Torque Specifications

Fastener Location	305/350 CID (5.0/5.7L) V-8 Engines		454/502 CID (7.4/8.2 L) V-8 Engines	
	Lbs. Ft. (N·m)	Lbs. In. (N·m)	Lbs. Ft. (N·m)	Lbs. In. (N·m)
Crankshaft Pulley to Harmonic Balancer	35 (42)		35 (42)	
Harmonic Balancer to Crankshaft	60 (81)		80 (109)	
Pump Mounting Bracket to Engine	30 (41)		30 (41)	
Recirculation Pump Pulley		240 (27)		240 (27)

Tools

MERCURY MARINE SPECIAL TOOLS	
91-93656A1	Pulley Installer

KENT-MOORE SPECIAL TOOLS	
Can be ordered from:	Kent-Moore Tools, Inc. 29784 Little Mack Roseville, MI 48066 Phone: (313) 574-2332
J-25034	Pulley Removal Tool

Sealants

92-34227	Quicksilver Perfect Seal

Precautions

⚠ WARNING

Be careful when working on fuel system components; gasoline is extremely flammable and highly explosive under certain conditions. Be sure battery is disconnected. Do not smoke or allow sources of spark or flame in the area while servicing. Wipe up any spilled fuel immediately.

⚠ CAUTION

Do not operate engine without cooling water being supplied to water pickup pump or water pump impeller will be damaged and subsequent overheating damage to engine may result.

⚠ WARNING

Always disconnect battery cables from battery before working on engine to prevent fire or explosion.

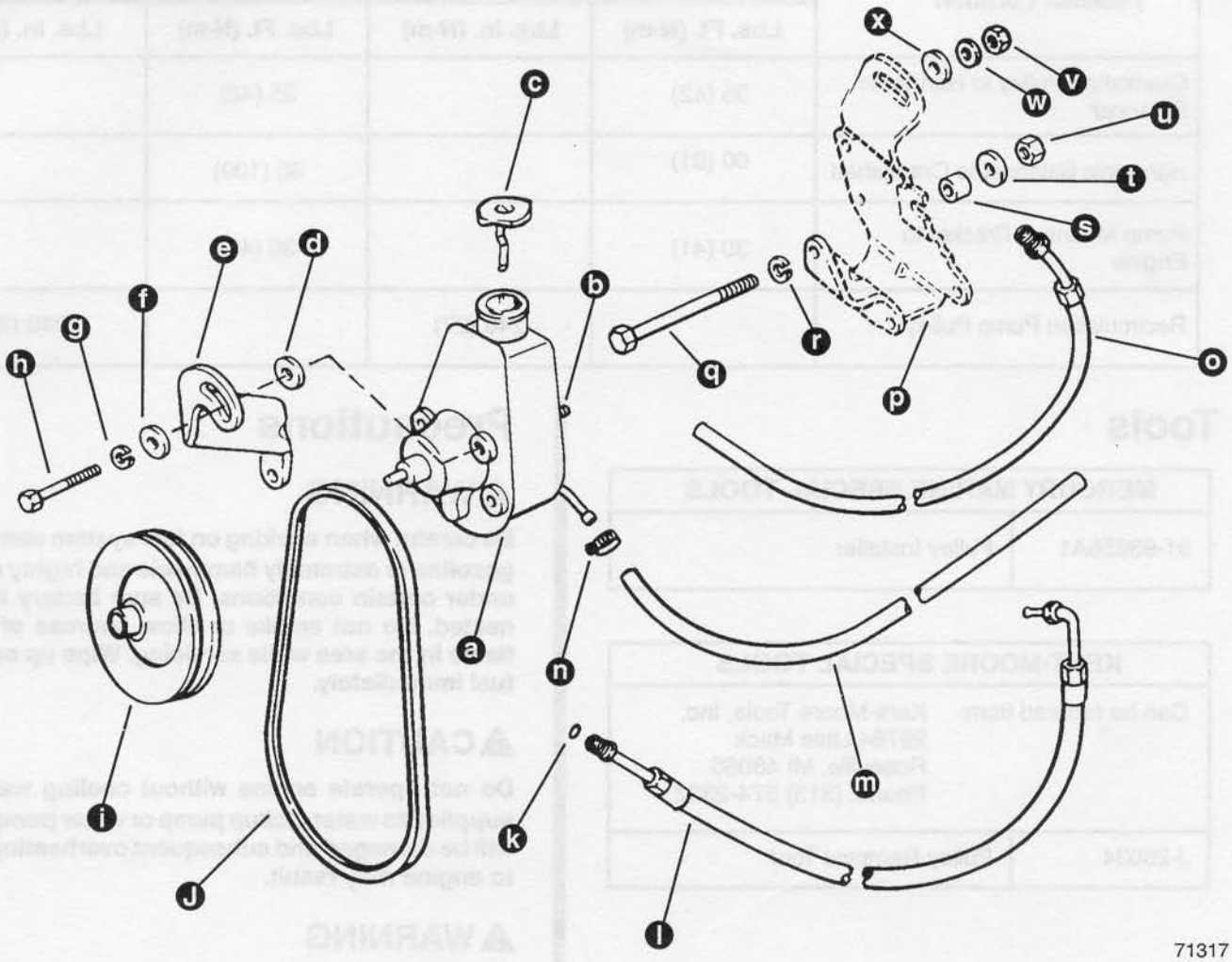
⚠ WARNING

Make sure not fuel leaks exist, before closing engine hatch.

⚠ CAUTION

Do not pry on power steering pump or alternator when adjusting belt tension. Serious damage may result.

Power Steering Pump and Components (Exploded View)

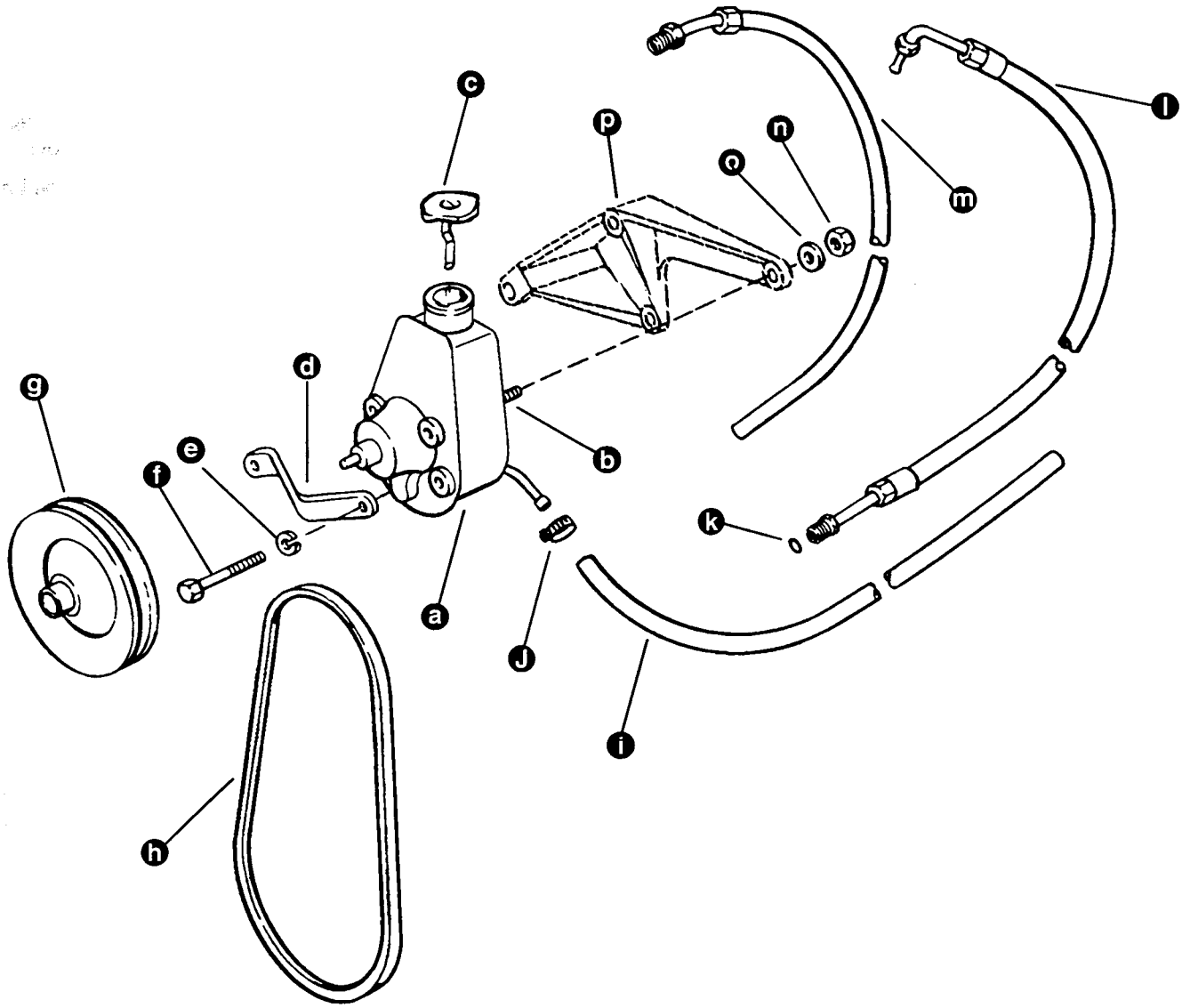


71317

a - Power Steering Pump Assembly
b - Stud
c - Cap
d - Spacer
e - Brace
f - Spacer
g - Lockwasher
h - Screw, Pump-to-Brace
i - Pulley
j - Belt
k - O-Ring, High Pressure Hose Fitting
l - Hose, High Pressure (Fittings On Both Ends)
m - Hose, Pump-to-Fluid Cooler
n - Clamp
o - Hose, Control Valve-to-Fluid Cooler (Fitting On One End)
p - Mounting Bracket, Stamped Steel
q - Screw, Pump-to-Bracket
r - Lockwasher
s - Spacer (Barrel Shaped)
t - Spacer
u - Nut (For "q")
v - Nut (For "b")
w - Washer
x - Spacer

305/350 CID (5.0/5.7 L) Engines

Power Steering Pump and Components (Exploded View)



71318

a - Power Steering Pump Assembly
b - Stud
c - Cap
d - Brace
e - Lockwasher
f - Screw, Pump-to-Brace
g - Pulley
h - Belt
i - Hose, Pump-to-Fluid Cooler
j - Clamp
k - O-Ring, High Pressure Hose Fitting
l - Hose, High Pressure (Fittings On Both Ends)
m - Hose, Control Valve-to-Fluid Cooler (Fitting On One End)
n - Nut (For "b")
o - Lockwasher
p - Mounting Bracket, Cast

454/502 CID (7.4/8.2 L) Engines

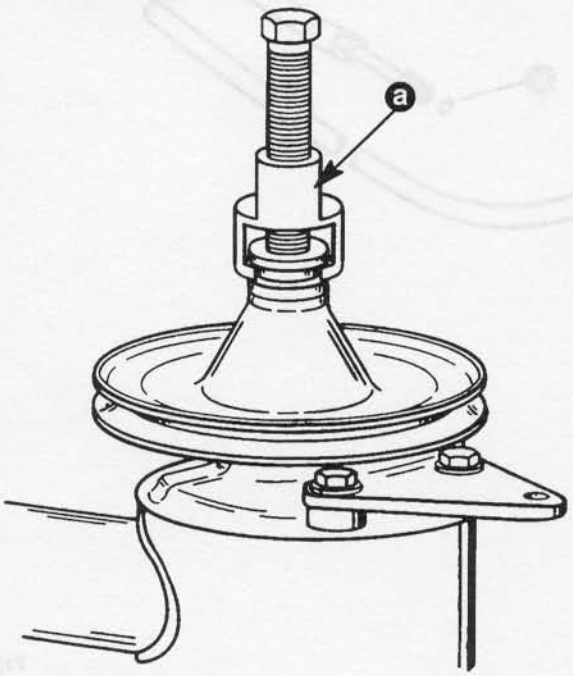
Important Service Information

Pump Pulley Replacement

REMOVAL

IMPORTANT: Kent–Moore Tool (J-25034) must be used to remove the pressed on pulleys used on poser steering pumps. This tool has an end on it that will not mushroom the end of the pump shaft. Do not use Kent-Moore Tool (J–21239) to remove these pulleys. This tool has a tapered end and will damage the shaft.

1. Install Kent-Moore Tool (J-25034 or J-21239-1) on end of pulley and shaft as shown.
2. While holding tool with suitable wrench, turn threaded screw until pulley is removed.



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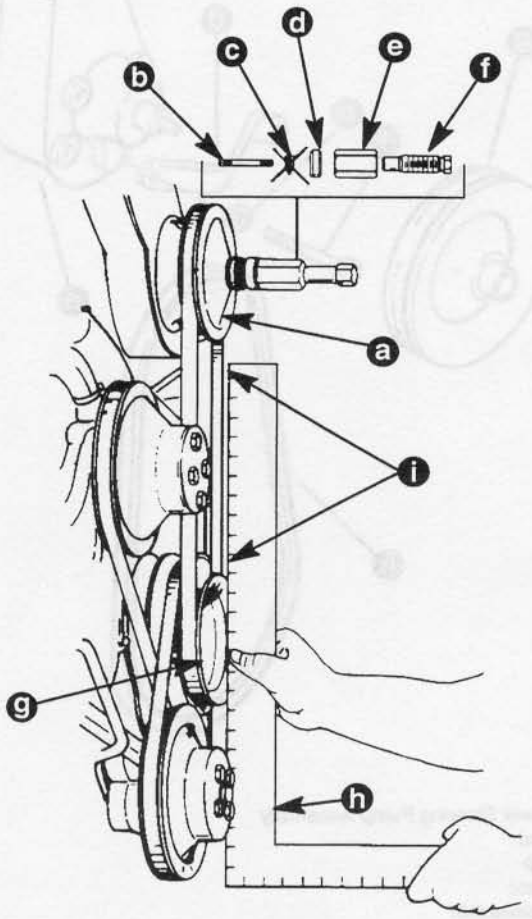
a – Kent-Moore Pulley Removal Tool (J-25034 or J-21239-1)

Power Steering Pump Pulley Removal

INSTALLATION

Install pulley,as follows, using Pulley Pusher Assembly 91-93656A1, and a long straight edge:

1. Place pulley on pump shaft.
2. Thread stud all-the-way into pump shaft. Place bearing over stud. Do not use spacer from kit.
3. Thread nut onto shaft. Thread tool shaft (and nut) all-the-way onto stud (threaded into pump pulley).
4. Using a long straight edge (to check drive belt alignment), turn large pusher nut until drive belt is parallel to straight edge.
5. Check pulley installation for correct alignment.



71320

a - Power Steering Pump Pulley
b - Stud
c - Do Not Use Spacer
d - Bearing
e - Nut
f - Tool Shaft
g - Crankshaft Pulley (Shown) or Water Circulating Pump Pulley
h - Long Straight Edge
i - Drive Belt Parallel

Testing and Repair

Refer to appropriate MerCruiser Stern Drive Service Manual.

Checking Pump Fluid Level

Refer to SECTION 1-B. (See "Table of Contents".)

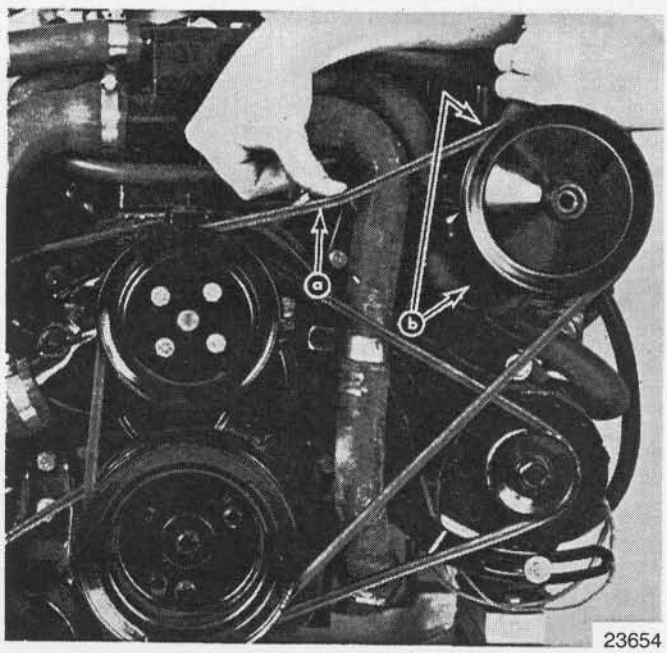
Filling and Air Bleeding System

Refer to SECTION 1-B. (See "Table of Contents".)

Pump Drive Belt Adjustment

IMPORTANT: Do not pry on pump with pry bar or screwdriver.

1. Install drive belt on pulleys and adjust tension as follows:
   a. Pivot pump away from engine, as required, until correct tension is obtained, as shown.
   b. After obtaining correct tension, securely tighten pump brace and pump mounting bolts.
2. If a new drive belt has been installed, recheck belt tension after running for five minutes.



23654

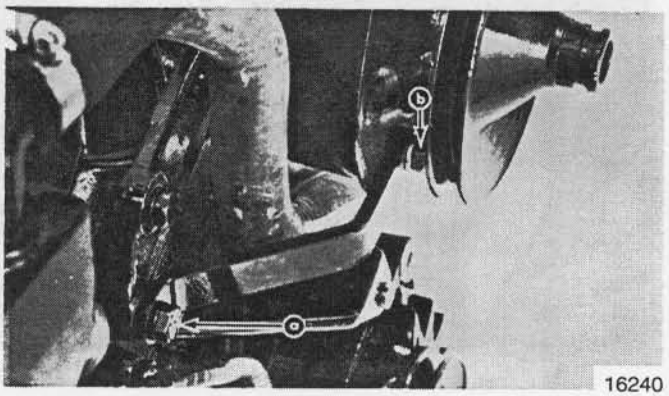
a - Belt Should Depress 1/4 in. (6mm)
b - Screws and Nuts

Typical

Pump Assembly

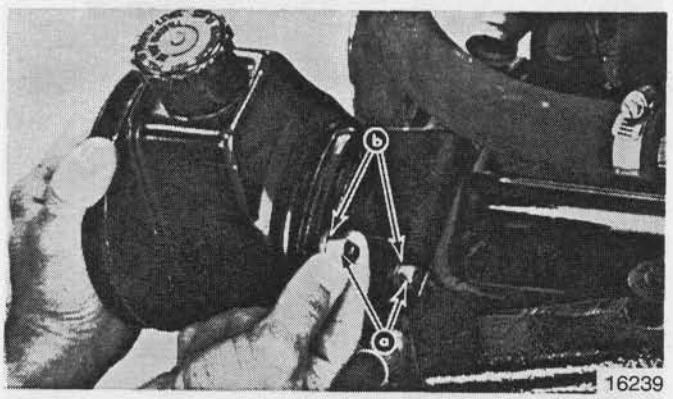
Removal

1. Loosen pump brace and pump mounting fasteners. Pivot pump to loosen belt. Remove drive belt.
2. Remove mounting fasteners from pump.



16240

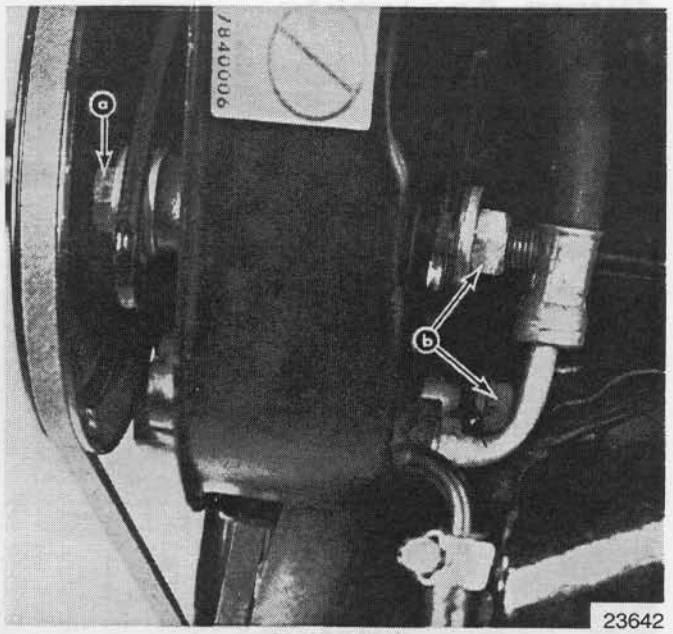
a - Bolt and Lockwasher
b - Metric Bolt and Lockwasher

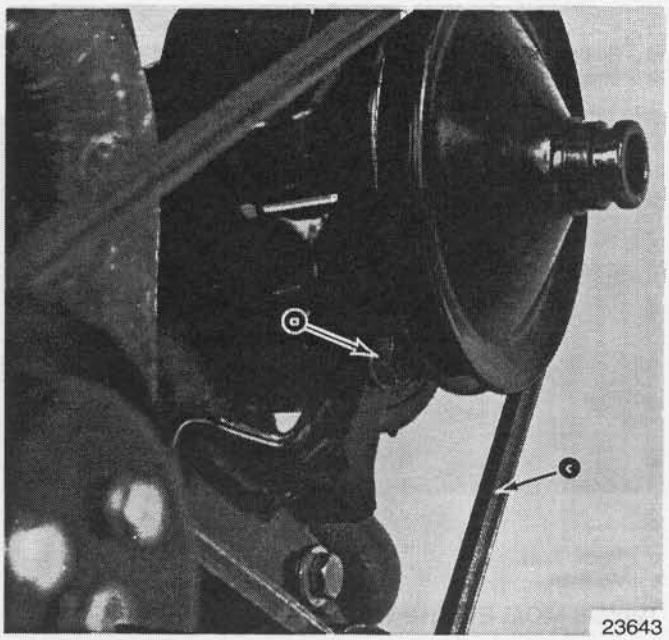


16239

a - Metric Nuts
b - Washers

Typical MCM Engine With Cast Mounting Bracket



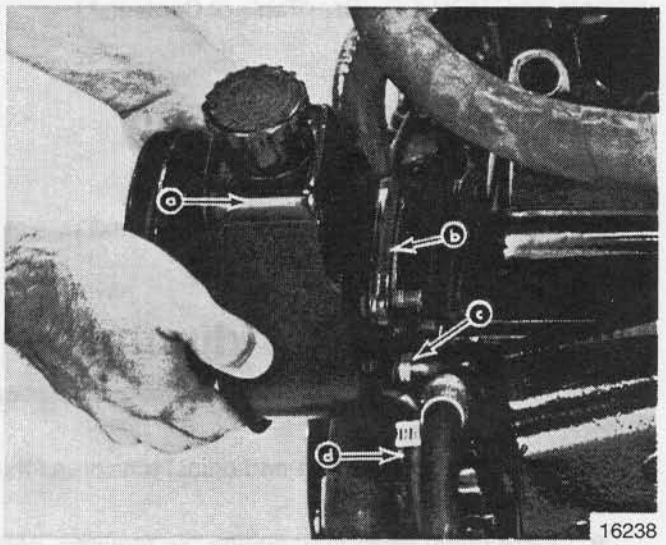


a - Screws
b - Nuts
c - Power Steering Belt

Typical MCM Engine With Stamped Steel Mounting Bracket

3. Remove pump assembly from bracket to gain access to fluid hoses.
4. Remove high pressure hose threaded fitting and O-Ring. Disconnect low pressure hose from back of pump assembly.

NOTE: Catch fluid that drains from pump and hoses in a suitable container.



a - Pump
b - Bracket
c - Threaded Fitting
d - Hose

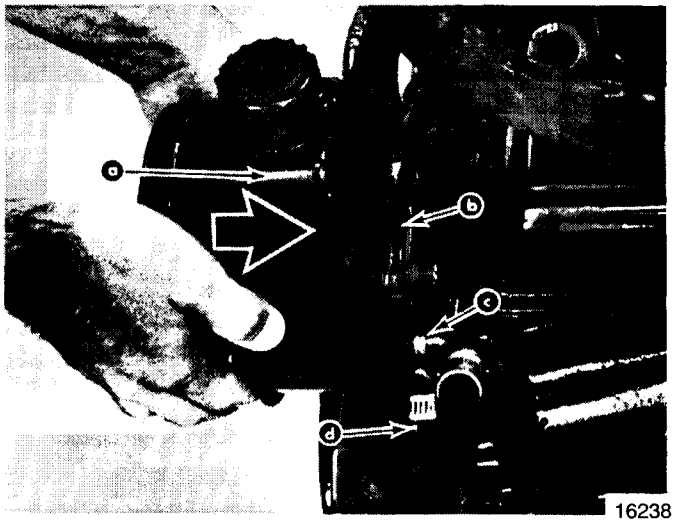
Typical

5. Refer to appropriate "Stern Drive Service Manual" for power steering pump repair procedures.

Installation

IMPORTANT: Be careful to not cross-thread or over-tighten hose fittings.

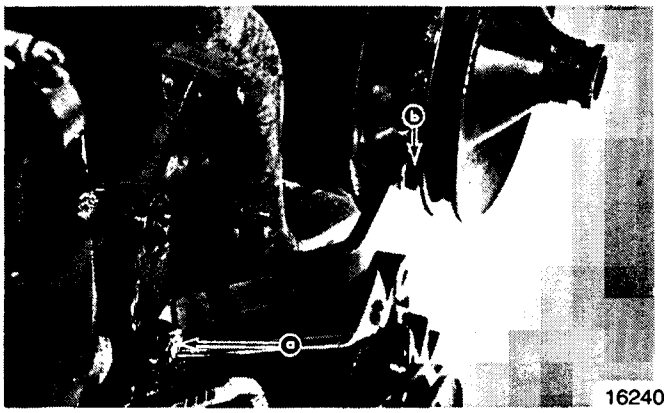
1. Be certain a new high pressure hose O-ring is present, and install threaded fitting in back of pump assembly. Tighten fitting securely. Connect low pressure hose on back of pump. Tighten hose clamp securely.



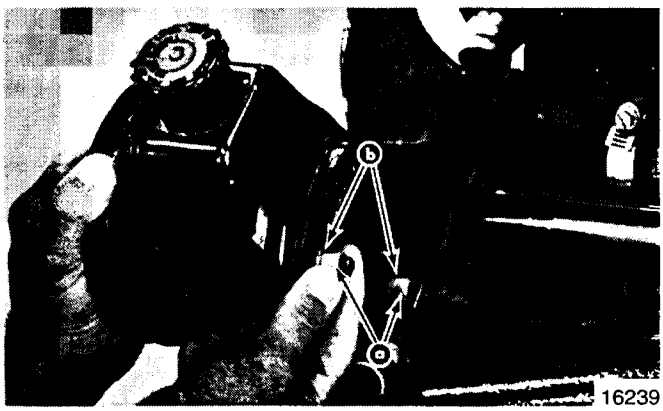
a-Pump
b - Bracket
c - Threaded Fitting (With O-Ring In Place - Not Visible In This View)
d - Hose (With Hose Clamp)

Typical

2. Install mounting hardware and fasteners to retain pump to bracket. (Refer to "Exploded View" for specific details on your engine.)



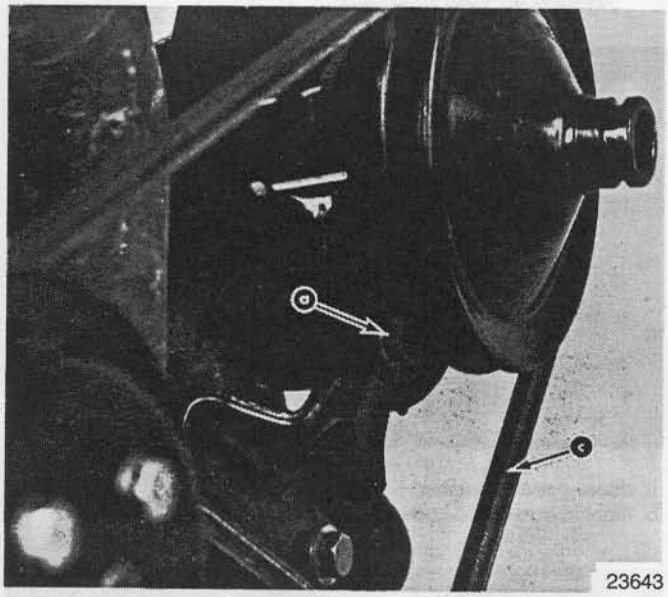
a - Screw and Lockwasher
b - Metric Screw and Lockwasher



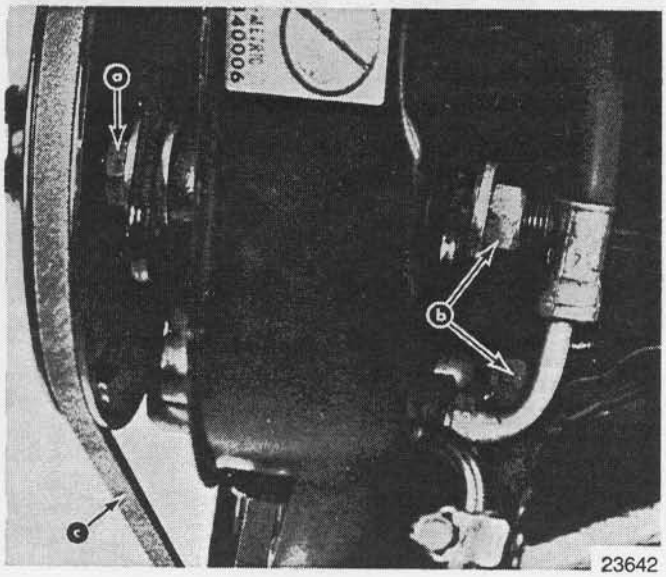
a - Metric Nuts
b - Washers

Typical MCM Engine With Cast Bracket

(Refer to "Exploded View" for specific details on your engine)

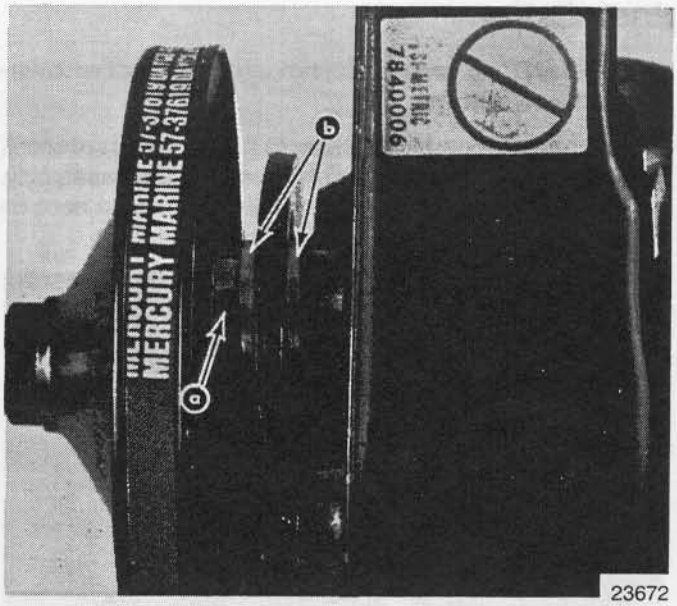


23643



23642

a - Screw With Lockwasher
b - Nuts (With Hardware)



23672

a - Metric Screw and Lockwashers
b - Spacers

Typical MCM Engine With Stamped Steel Bracket

3. Install drive belt and adjust tension. Refer to "Pump Drive Belt Adjustment" as previously outlined.
4. Fill and air bleed system. Refer to SECTION - 1B, MAINTENANCE (see "Table of Contents").

Mounting Brackets

Mounting brackets, either cast or stamped steel, are removable after pump assembly (refer to previous instructions) and alternator (refer to SECTION - 4C, CHARGING) have been removed. See "Exploded Views" and "Torque Specifications".

Hydraulic Hoses and Fluid Cooler

Refer to SECTION 6A - Seawater Cooled Models or SECTION 6B - Closed Cooled Models for information on testing or servicing power steering fluid coolers. The following is provided to assist in replacement of power steering fluid hoses and to assure proper routing and connection to the cooler.

Replace high or low pressure hoses following:

IMPORTANT: Make hydraulic connections as quickly as possible to prevent fluid leakage.

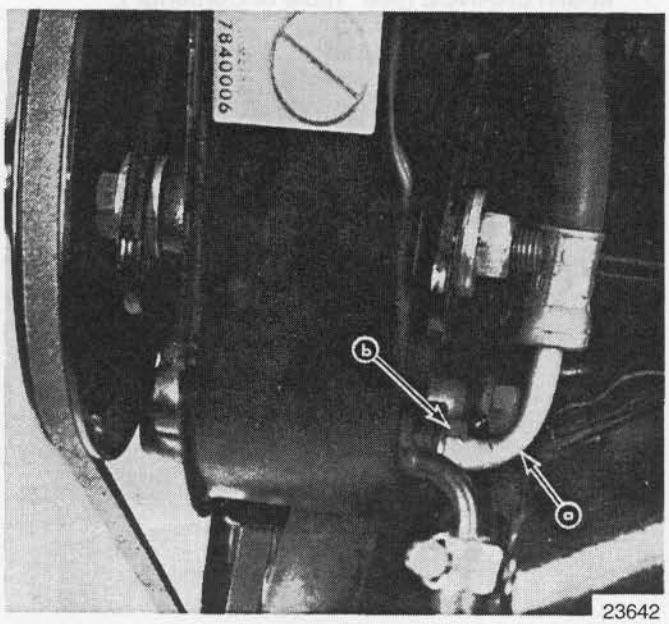
IMPORTANT: Be careful to not cross-thread or overtighten hose fittings.

High Pressure Hose (Pump-to-Control Valve)

REMOVAL

NOTE: Catch fluid that drains from pump and hoses in a suitable container.

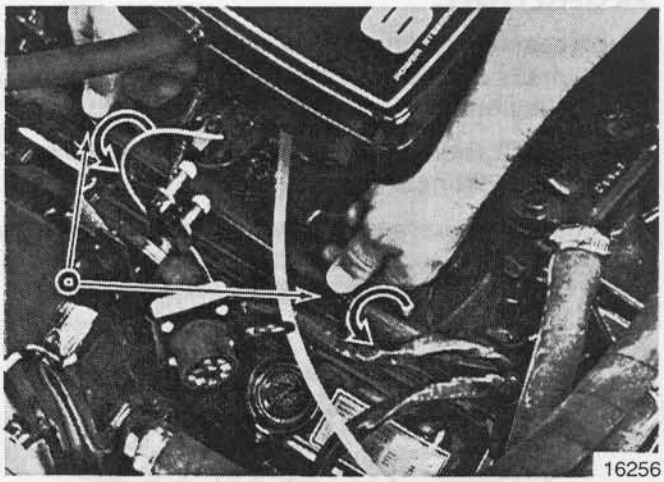
1. Remove high pressure hose fitting and O-ring seal from rear of pump.



23642

a - High Pressure Hose
b - Fitting (With O-Ring - Not visible In This View)

2. Remove hose where routed and secured (port or starboard side), across top of engine, near valve cover.

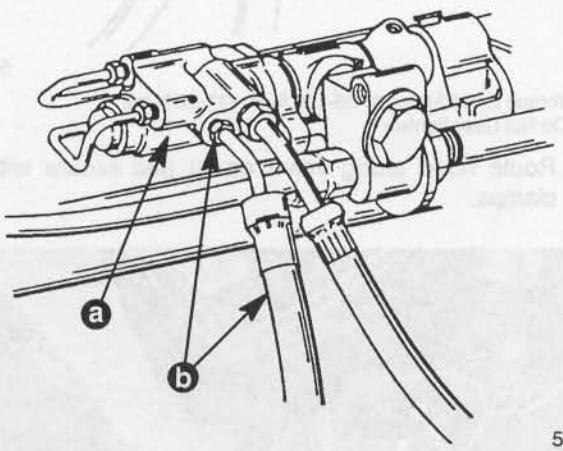


16256

a - J-Clamps

Typical Starboard Routing (Similar On Models With Port Routed Hose)

3. Remove small fitting from control valve at transom. Remove hose.



50912

a - Control Valve
b - Small Fitting and Hose

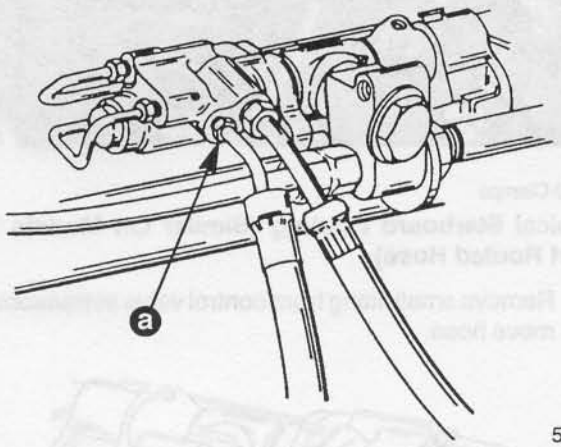
INSTALLATION

⚠CAUTION

Route hoses exactly as shown below. This will help avoid stress on the hose fittings and will help avoid kinks in the hoses.

IMPORTANT: Be careful to not cross-thread or over-tighten hose fittings.

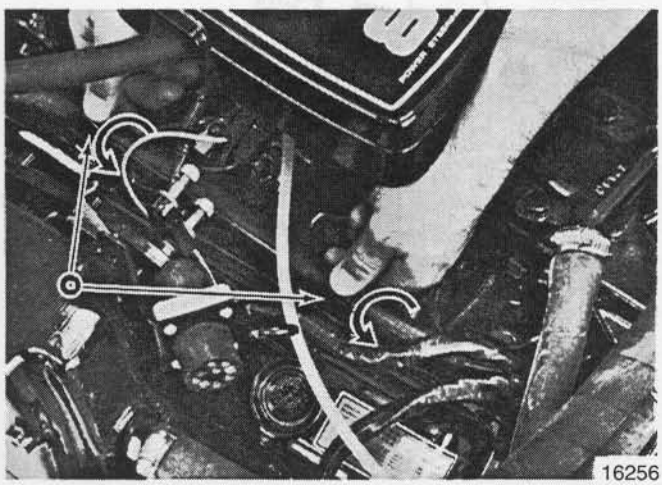
1. Thread fitting into control valve. Position hose properly (as prior to removal) and torque fitting to 96-108 lb. in. (11-12 N·m). Do not cross-thread or over-tighten.



50912

a - Torque Small Fitting to 96-108 lb.in. (11-12 N·m). Do Not Over-tighten.

2. Route hose along valve cover and secure with J-clamps.

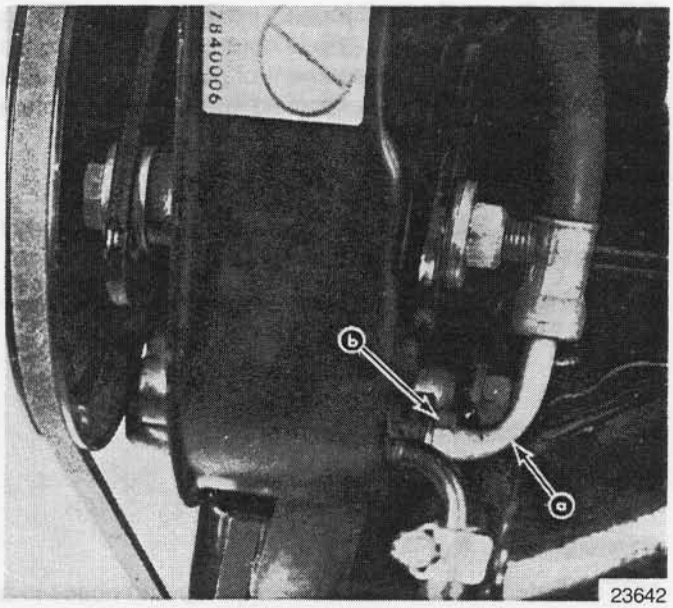


16256

a - J-Clamps

Typical Starboard Routing (Similar On Models With Port Routed Hose)

3. Be certain a new high pressure hose O-ring is present, and install threaded fitting in back of pump assembly. Tighten fitting securely. Do not cross-thread or over-tighten.



23642

a - Threaded Fitting - (With O-Ring In Place - Not Visible In This View)

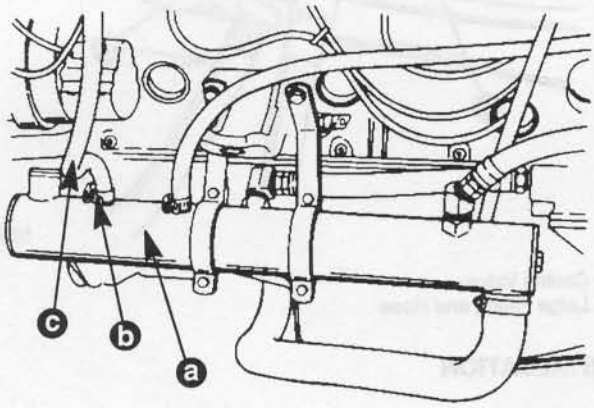
4. Fill and air bleed system. Refer to SECTION - 1B, MAINTENANCE (see "Table of Contents").

Low Pressure Hose (Cooler-to-Pump)

REMOVAL

NOTE: Catch fluid that drains from hose, cooler and pump in a suitable container.

1. Loosen hose clamp and remove hose from fluid cooler.

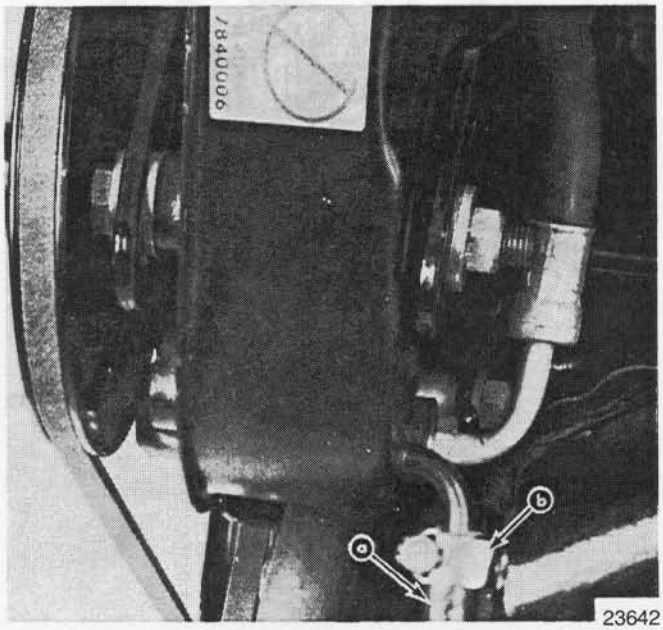


70584

a - Fluid Cooler
b - Hose Clamp
c - Hose

7.4L/454 Magnum Power Steering Fluid and Engine Oil Cooler Shown
(Others Similar, Except Power Steering Only)

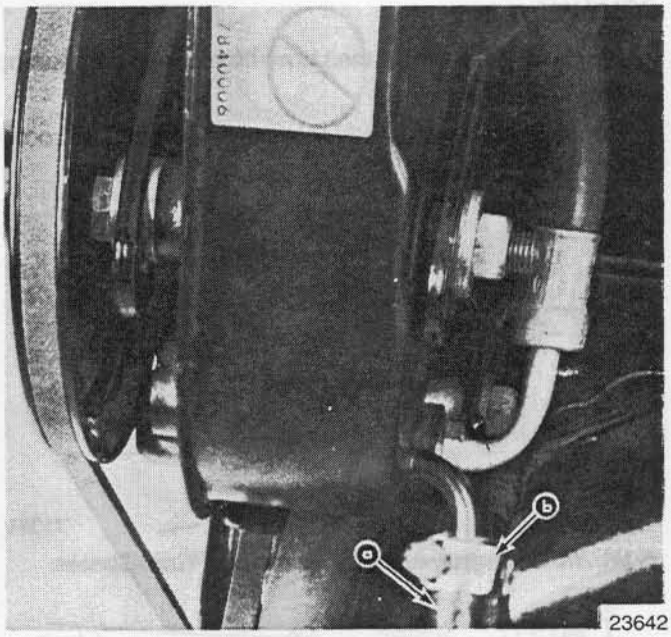
2. Loosen hose clamp and remove hose from back of pump.



a - Hose Clamp
b - Hose

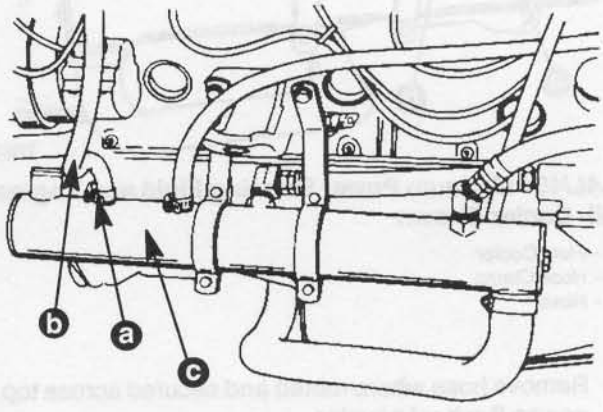
INSTALLATION

1. Using hose clamp, install new hose on back of pump. Tighten clamp securely.



a - Hose Clamp
b - Hose

2. Using hose clamp, install hose on fluid cooler. Tighten clamp securely.



70584

a - Hose Clamp
b - Hose
c - Fluid Cooler

7.4L/454 Magnum Power Steering Fluid and Engine Oil Cooler Shown
(Others Similar, Except Power Steering Only)

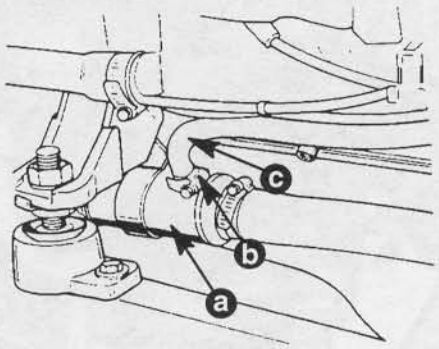
3. Fill and air bleed system. Refer to SECTION - 1B, MAINTENANCE (see "Table of Contents").

Low Pressure Hose (Control Valve-to-Cooler)

REMOVAL

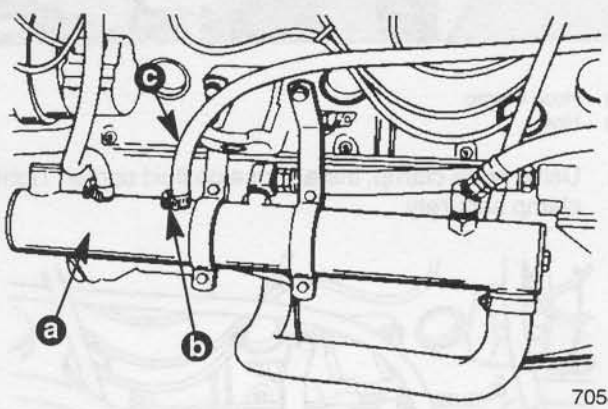
NOTE: Catch fluid that drains from hose, cooler and pump in a suitable container.

1. Loosen hose clamp and remove hose from fluid cooler.



71334

5.0/5.7/350 Magnum Power Steering Fluid Cooler

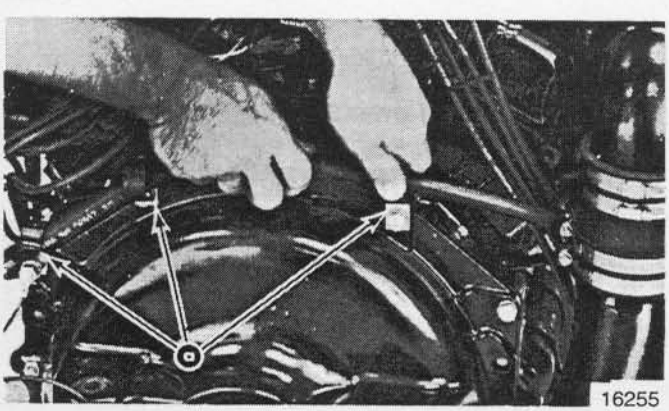


70584

7.4L/454 Magnum Power Steering Fluid and Engine Oil Cooler Shown

a - Fluid Cooler
b - Hose Clamp
c - Hose

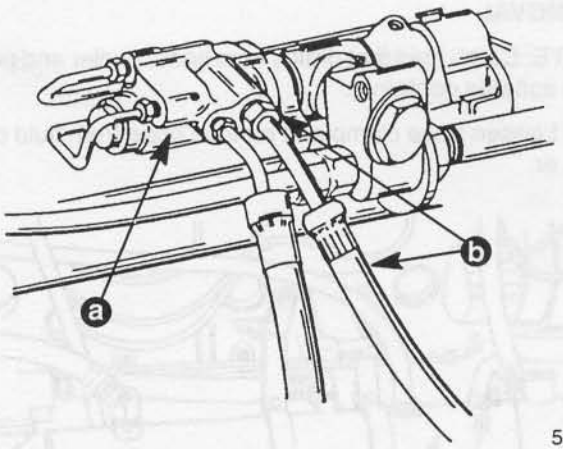
2. Remove hose where routed and secured across top of engine flywheel housing.



16255

a - J-Clamps

3. Remove large fitting from control valve at transom. Remove hose.



50912

a - Control Valve
b - Large Fitting and Hose

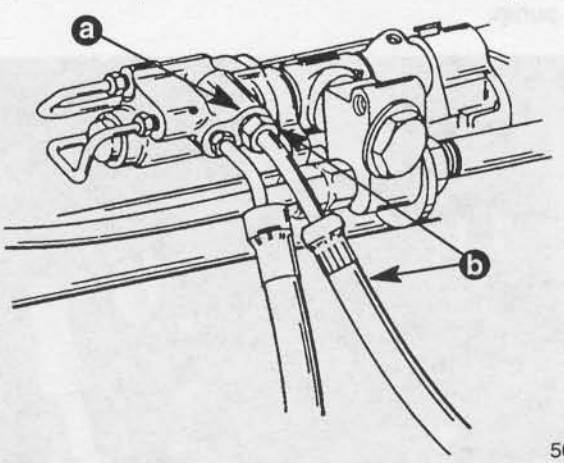
INSTALLATION

⚠CAUTION

Route hoses exactly as shown below. This will help avoid stress on the hose fittings and will help avoid kinks in the hoses.

IMPORTANT: Be careful to not cross-thread or over-tighten hose fittings.

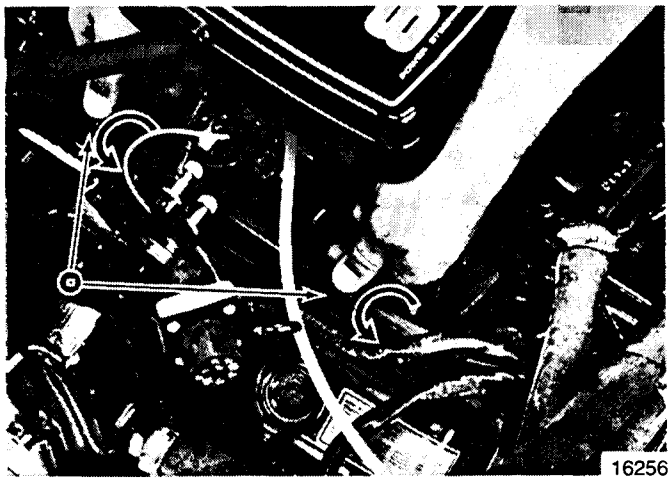
1. Thread fitting into control valve. Position hose properly (as prior to removal) and torque fitting to 20-25 lb. ft. (27-34 N·m). Do not cross-thread or over-tighten.



50912

a - Control Valve
b - Torque Large Fitting to 20-25 lb. ft. (27-34 N·m). Do Not Over-tighten

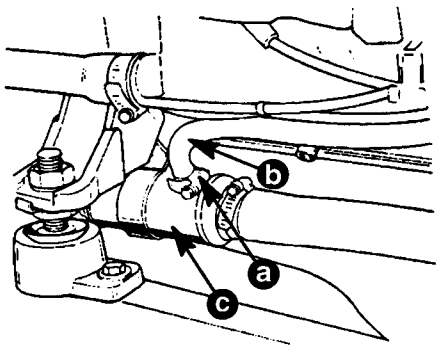
2. Route hose along flywheel housing and secure with J-clamps.



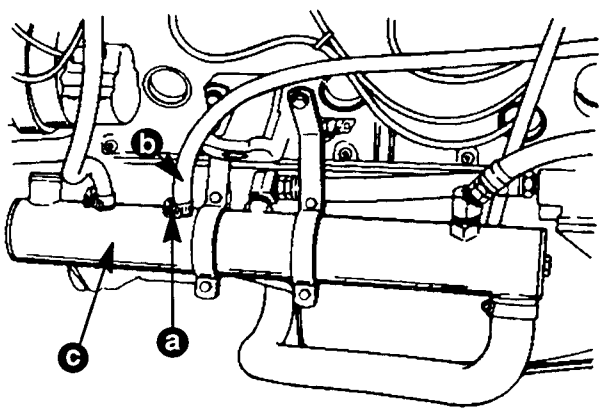
a - J-Clamps

Typical

3. Using hose clamp, install hose on fluid cooler. Tighten clamp securely.



5.0/5.7/350 Magnum Power Steering Fluid Cooler



7.4L/454 Magnum Power Steering Fluid and Engine Oil Cooler

a - Hose Clamp
b - Hose
c - Fluid Cooler

4. Fill and air bleed system. Refer to SECTION - 1B, MAINTENANCE (see "Table of Contents").

Priority Valve Kit (79691A1) Information

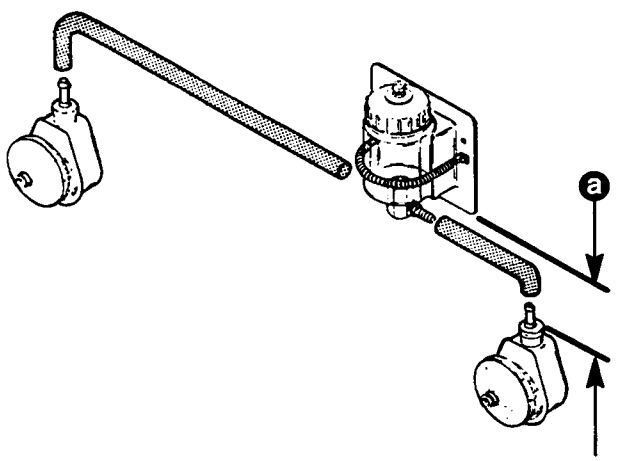
This Kit information (in "Installation Instruction" form) is provided to assist personnel when servicing Dual Installations where both engines are equipped with Power Steering Pumps, Coolers, Related Hardware and Hoses and One Transom Assembly is equipped with Power Steering.

Although the system may already be installed, refer to appropriate sections and follow instructions that relate to your task, when servicing those components.

NOTE: A System Flow Diagram is located on the last page of this SECTION.

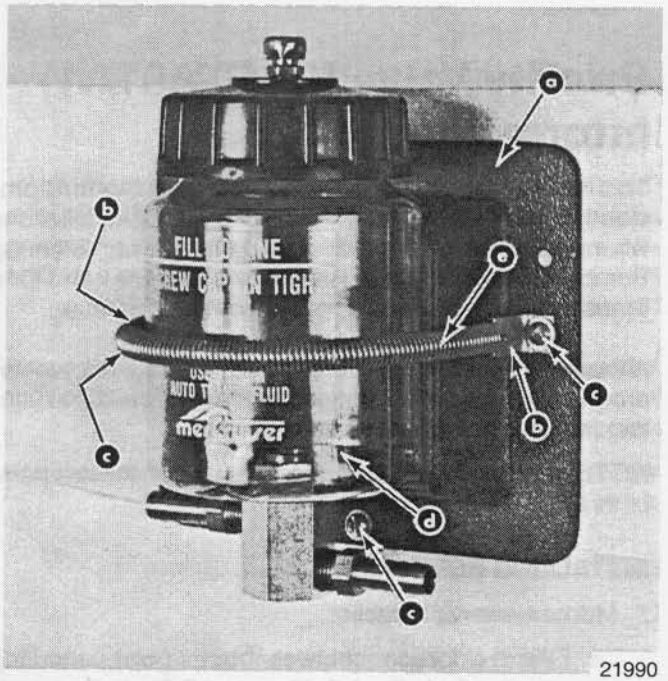
INSTALLING RESERVOIR

1. Mount reservoir bracket.
   a. Find a location between both power steering pumps that affords both accessibility and easy visual inspection of fluid level. Location must be at least 6 in. (152mm) higher than pump cap to allow fluid from reservoir to flow freely to pumps. (Preferably on transom or on forward engine compartment wall).
   b. Install reservoir mounting bracket with hardware supplied.



a - Measurement - 6 in. (152mm)

2. Position bottle reservoir in mounting bracket and secure with retainer spring.

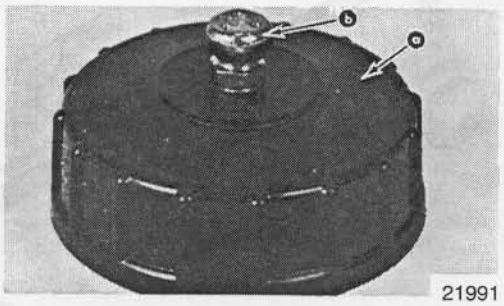


21990

a - Reservoir Bracket
b - Reservoir Spring Retainer Tab
c - Screw and Washer
d - Reservoir Bottle
e - Retainer Spring

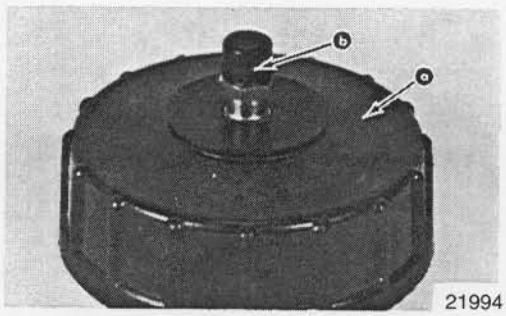
IMPORTANT: A two way valve is required on the reservoir cap for cold weather operation below 40 degrees F. (4 degrees C).

3. If required, install two way valve in reservoir cap.



21991

a - Reservoir Cap
b - Vent (Remove)



21994

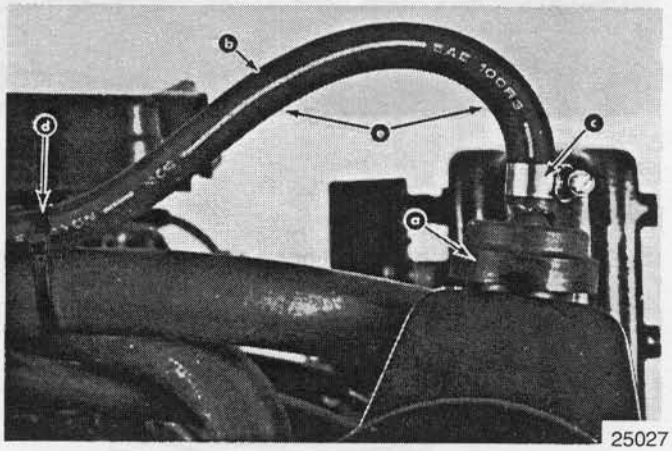
a - Reservoir Cap
b - Two-Way Valve (Installed)

4. Cut two hose (from bulk hose supplied) of sufficient length to extend from bottom fittings on reservoir to fill caps on power steering pumps. Allow extra hose for routing.

IMPORTANT: When routing and installing hoses in the following steps, be sure that the bend radius in the hose is sufficient to eliminate a load being placed on power steering pump fill cap.

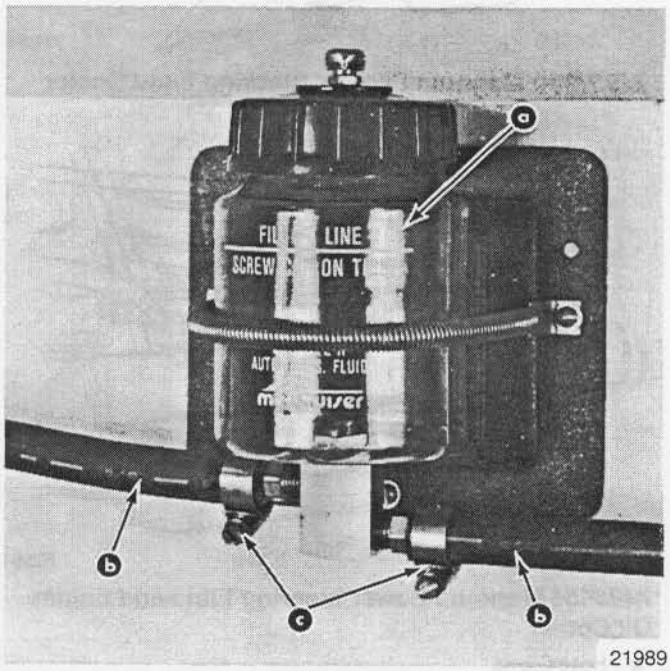
5. Connect hoses that were just cut to reservoir and power steering pump caps (from kit).

6. Secure hoses with sta-straps to keep them below reservoir fluid level line, and away from heat and moving parts.



25027

a - Power Steering Pump Cap (Port and Starboard)
b - Hose to Reservoir
c - Hose Clamp - Tighten Securely
d - Sta-Straps
e - Bend Radius (Port and Starboard)

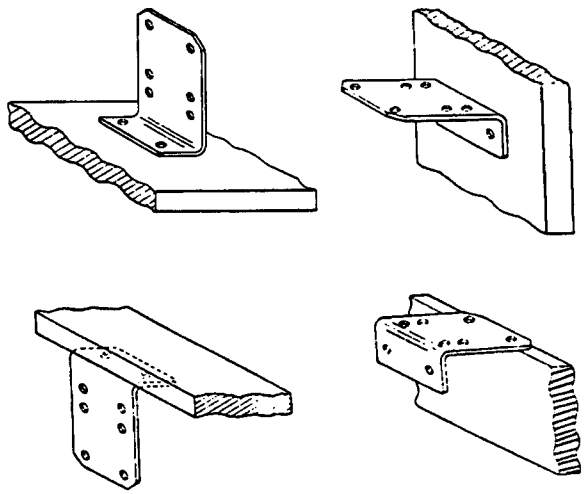


21989

a - Reservoir
b - Hoses from Pumps
c - Hose Clamps - Tighten Securely

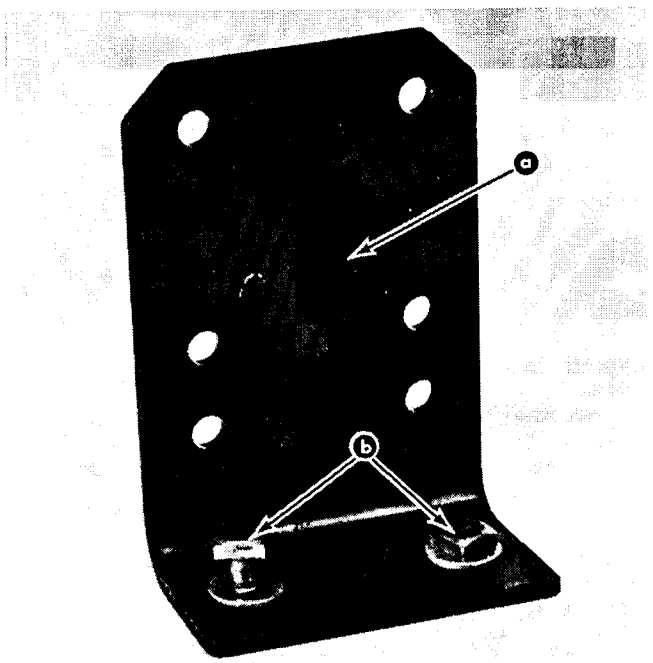
INSTALLING PRIORITY VALVE

NOTE: Priority valve mounting bracket can be used in various mounting configurations.



71403

1. Install priority valve mounting bracket.
   a. Find a central location that will be accessible for making and checking hose connections. Ensure that location will allow 2 in. (51mm) or more, above and below priority valve for hose connections and routing. (Preferably on a stringer near transom).
   b. Mount bracket using lag bolts and washers supplied.

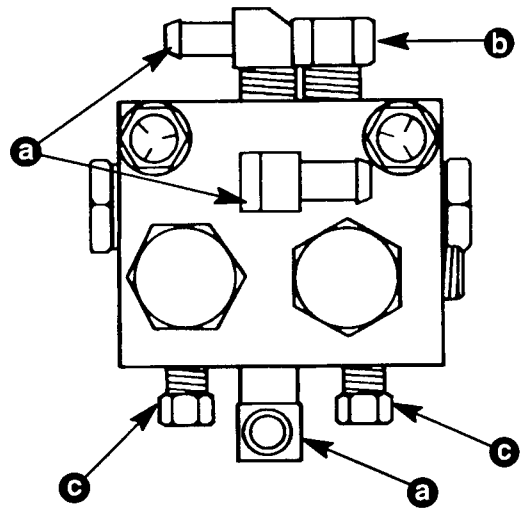


21998

a - Mounting Bracket
b - Lag Bolts and Washers

NOTE: The 90 degree fitting locations on priority valve are marked with a "T" stamped into the valve.

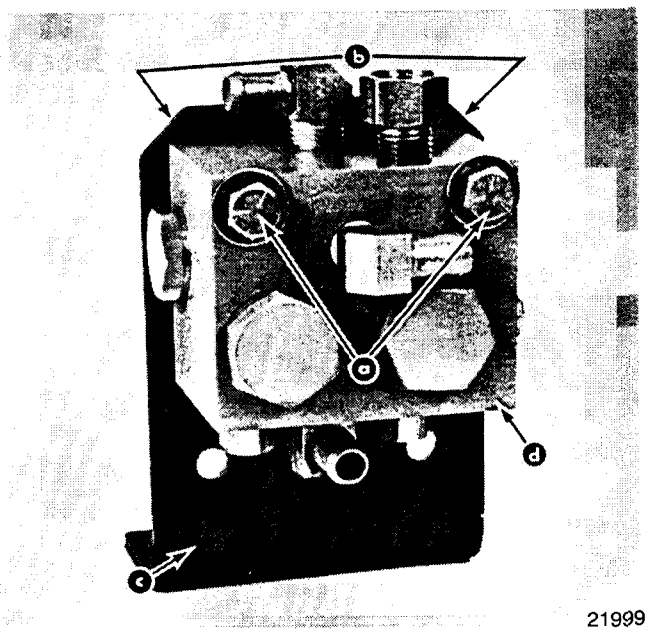
2. Apply liquid pipe joint sealer to threads and install fittings into priority valve.



71404

a - 90 Degree Elbow
b - Large Inverted Flare Fitting
c - Small Inverted Flare Fitting

3. Mount priority valve on bracket.

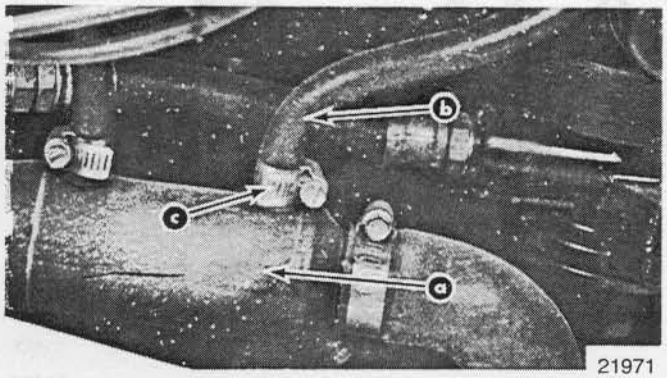


21999

a - Bolt and Washer - Torque to 10 lb. ft. (14 N·m)
b - Washer and Nut
c - Bracket
d - Priority Valve

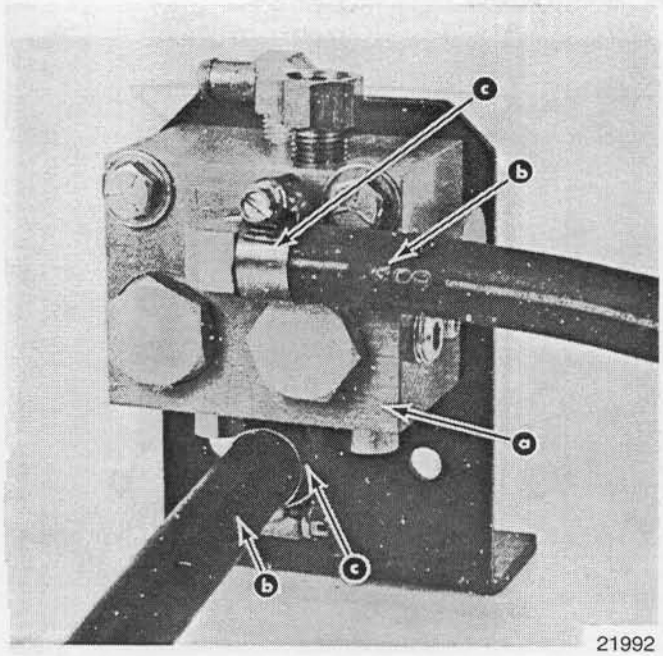
NOTE: Engines with power steering are equipped with a hose that is connected to the power steering fluid cooler and has a fitting on the other end that would normally be connected to the power steering control valve. These hoses are not used and are replaced with bulk hose supplied with priority valve kit.

4. Remove and discard old hoses which are connected to power steering coolers. (Port and Starboard)
5. Cut two hoses (from bulk hose supplied) of sufficient length to extend from power steering coolers to respective fittings on priority valve.
6. Connect one end of each hose to its respective power steering fluid cooler and other ends to fittings on priority valve.



21971

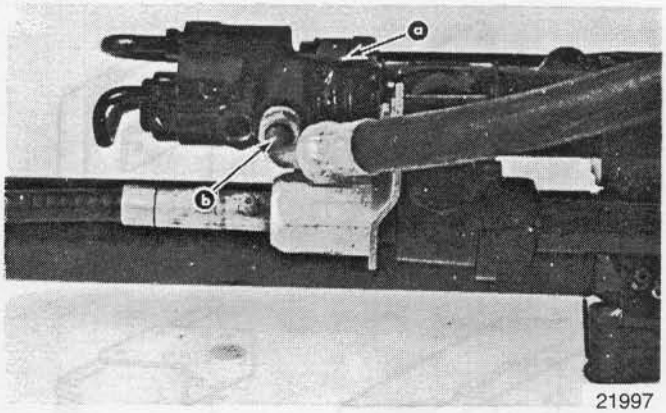
a - Power Steering Fluid Cooler
b - Hose
c - Hose Clamp - Tighten Securely



21992

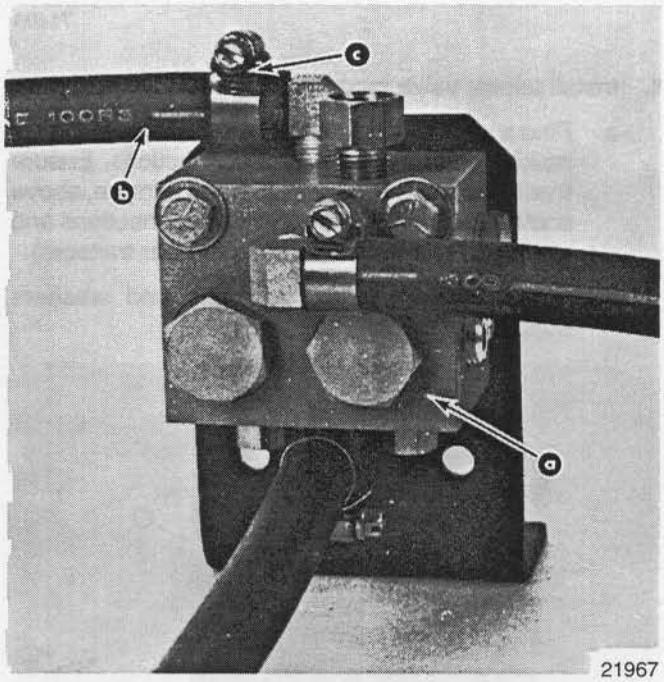
a - Priority Valve
b - Hose
c - Hose Clamp - Tighten Securely

7. Install return hose (large fitting on one end only, from kit) to power steering control valve. Route hose to priority valve, cut hose to length, and connect to fitting on priority valve.



21997

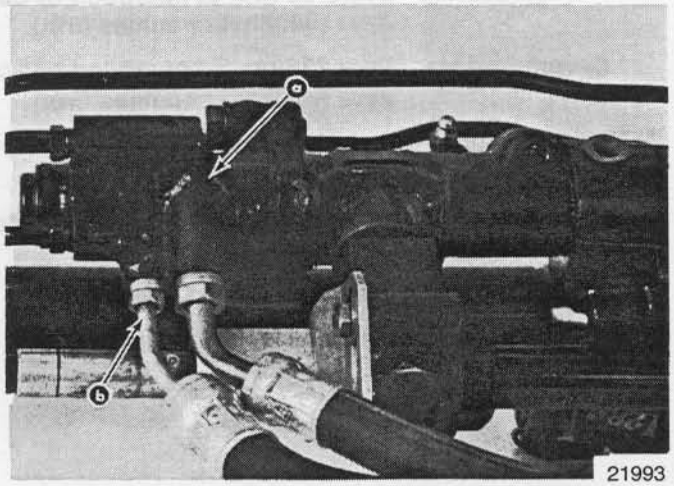
a - Power Steering Control Valve
b - Hose Fitting - Tighten Securely



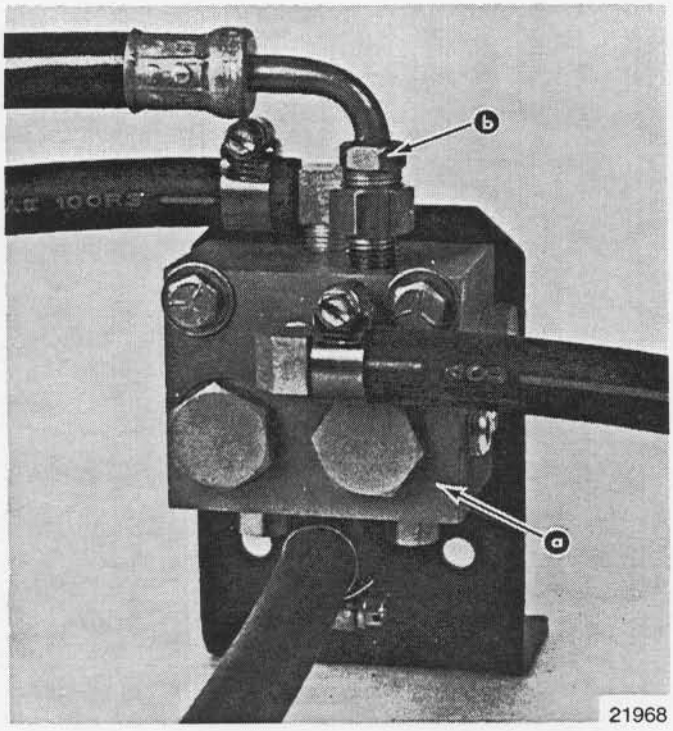
21967

a - Priority Valve
b - Hose
c - Hose Clamp - Tighten Securely

8. Install pressure hose (fittings on both ends, from kit) between power steering control valve and large inverted flare fitting on priority valve. (This fitting location is marked with a "S").

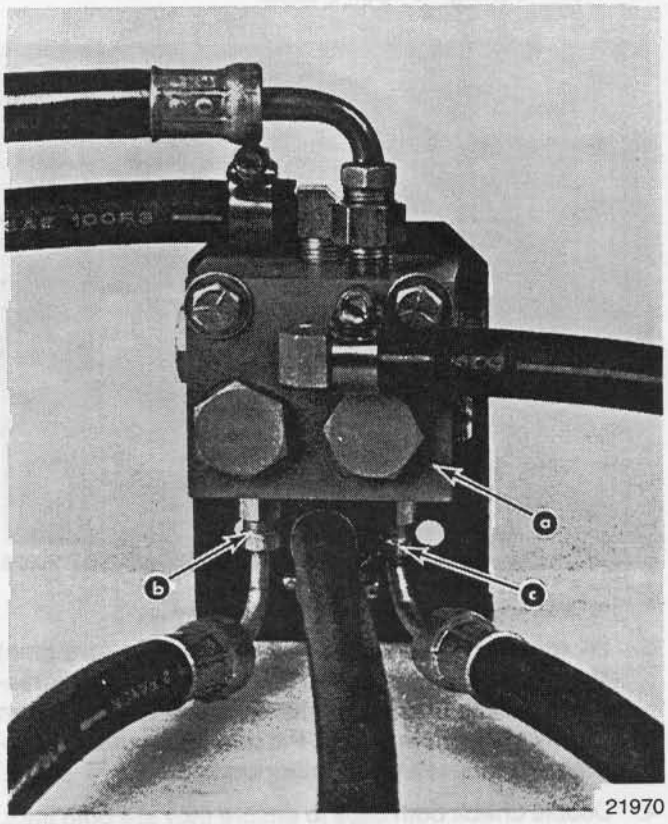


a - Power Steering Control Valve
b - Hose Fitting - Tighten Securely



a - Priority Valve
b - Hose Fitting - Tighten Securely

9. Connect No. 1 (starboard) engine pressure hose (from pump) to inverted flare fitting marked by "1" on priority valve. Connect No. 2 (port) pressure hose (from pump) to inverted flare fitting marked by "2" on priority valve.

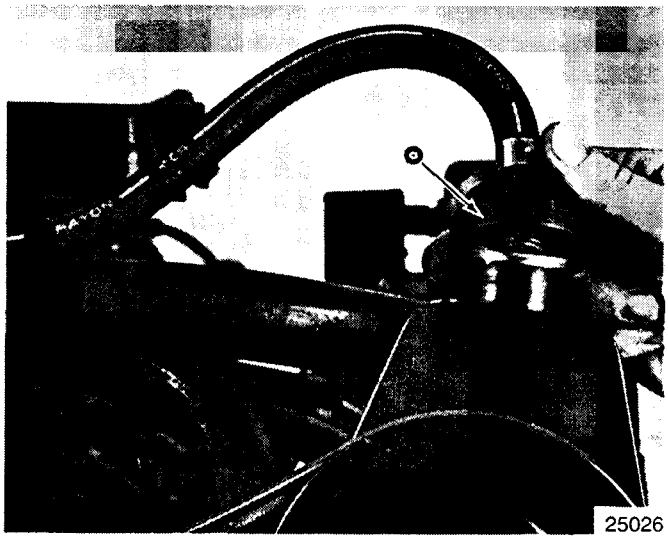


a - Priority Valve
b - No. 1 (Starboard) Pressure Hose - Tighten Securely
c - No. 2 (Port) Pressure Hose - Tighten Securely

10. Secure all hoses with sta-straps provided.

FILLING SYSTEM WITH FLUID

1. Fill pump reservoirs with automatic transmission fluid (ATF) Dexron II.
2. Install and tighten pump caps.



a - Turn Cap Clockwise Approximately 120 Degrees

3. Fill reservoir bottle to full mark, then (one at a time) slightly loosen pump cap to allow fluid to flow from reservoir to pump until pump just starts to overflow, then quickly tighten pump cap. Fill bottle reservoir and repeat this process for the other pump.
4. Double check both caps to ensure they are both tight.

MAINTENANCE

Maintenance inspection is the owner's responsibility and must be performed at intervals specified, following:

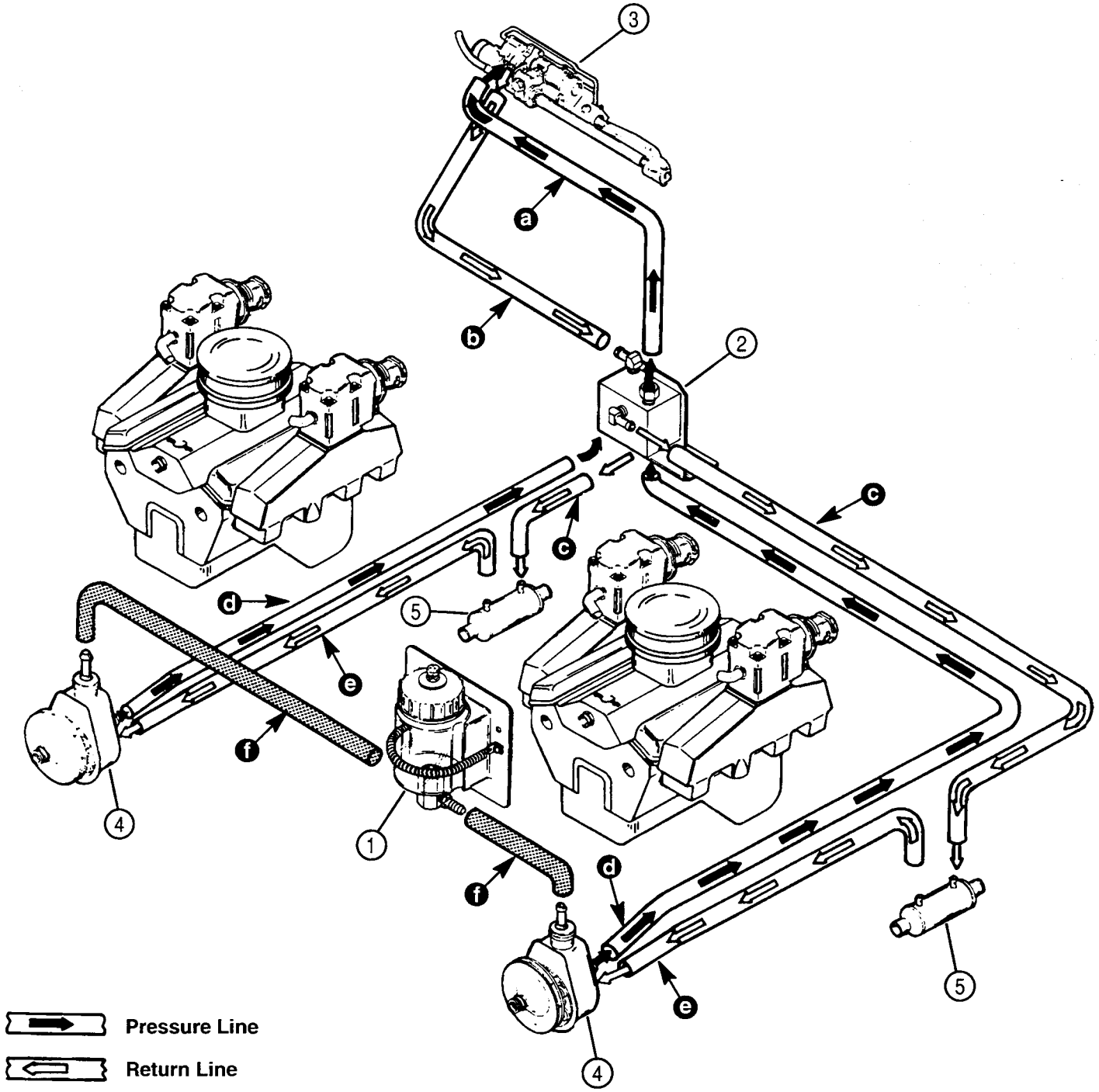
Normal Service - Every 50 hrs. of operation or 60 days (whichever comes first)

Severe Service - Every 25 hrs. of operation or 30 days (whichever comes first)

NOTE: Operation in salt water is considered "Severe Service.

1. Check all connections and hose clamp for adequate tightness. Tighten, if loose.
2. Check all mounting bolts and tighten if necessary.
3. Be sure to check reservoir oil level periodically.

SYSTEM FLOW DIAGRAM



Pressure Line

Return Line

Gravity Feed Line

71405

1 - Reservoir Bottle and Bracket
2 - Priority Valve and Mounting Bracket
3 - Power Steering Control Valve
4 - Power Steering Pump
5 - Power Steering Fluid Cooler

a - Pressure Hose (Fitting on Both Ends - Supplied in Kit)
b - Return Hose (Fitting on One End - Supplied in Kit)
c - Return Hose From Pump (Cut from Bulk Hose Supplied)
d - Pressure Hose From Pump
e - Return Hose From Pump
f - Gravity Feed Hose (Cut from Bulk Hose Supplied)